Aviation Week and Space Technology

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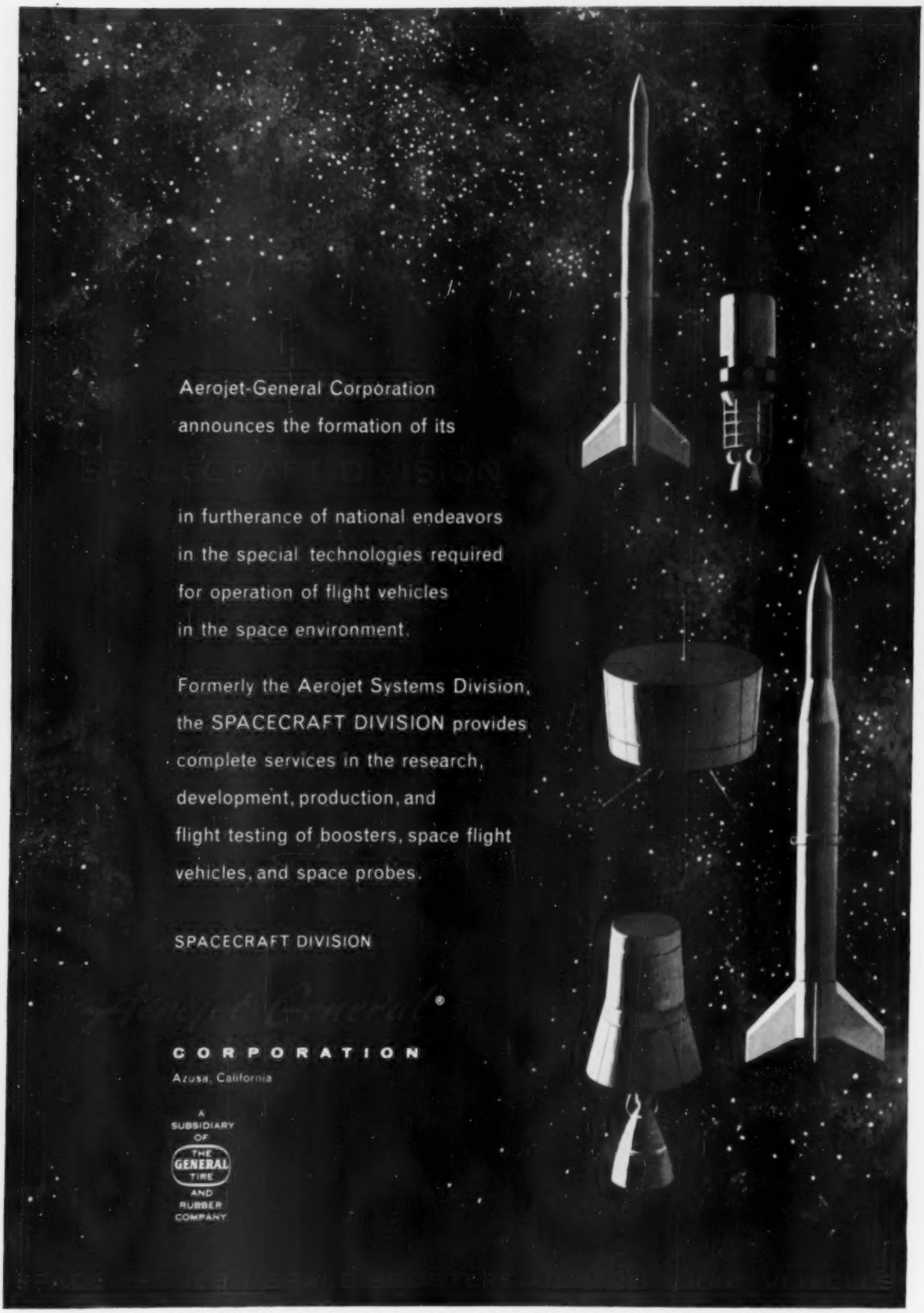
A McGraw-Hill Publication

October 3, 1960

Companies Study Anti-Satellite Techniques

Convair 880 Transport, B-58 Bomber And F-106 Fighter Fly in Formation


Aerojet-General Corporation
announces the formation of its
in furtherance of national endeavors
in the special technologies required
for operation of flight vehicles
in the space environment.
Formerly the Aerojet Systems Division,
the SPACECRAFT DIVISION provides
complete services in the research,
development, production, and
flight testing of boosters, space flight
vehicles, and space probes.
SPACECRAFT DIVISION
CORPORATION
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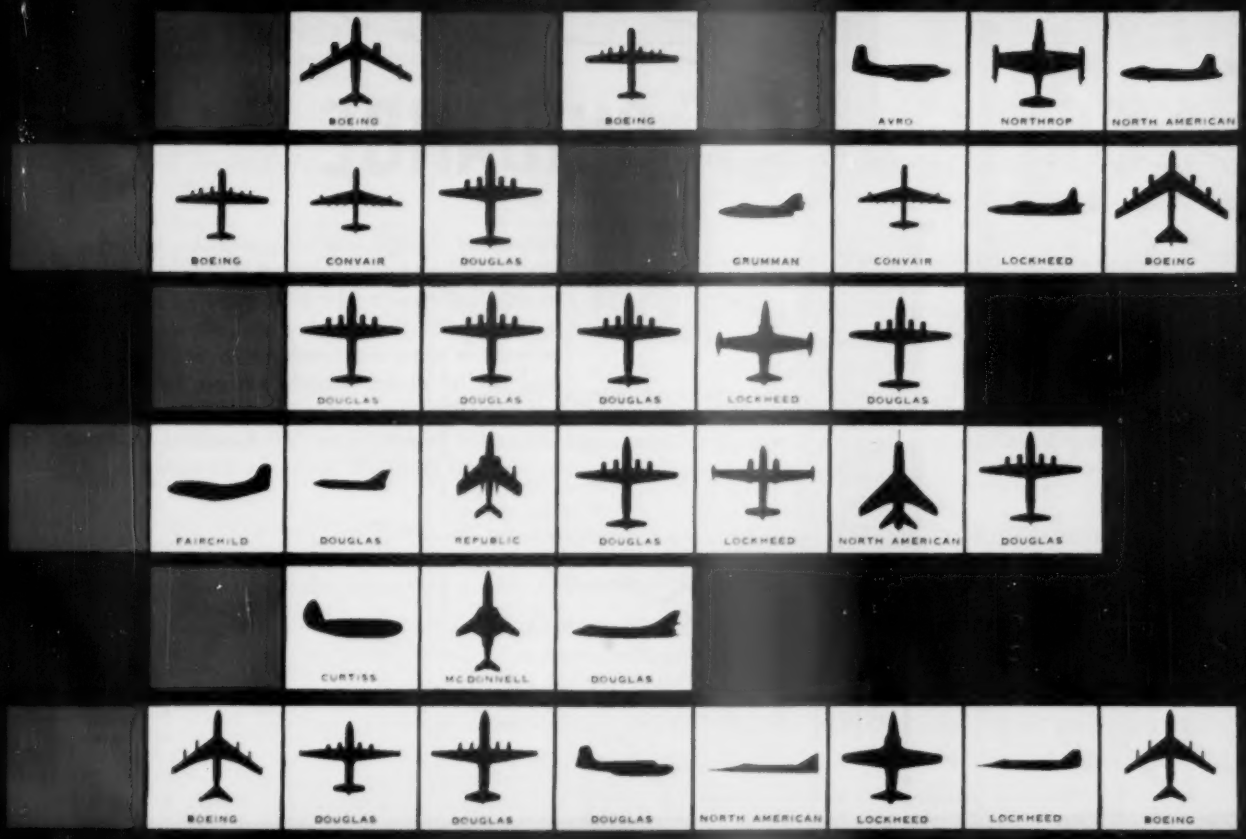
Engineers, scientists—investigate outstanding opportunities at Aerojet.



Since 1948, far more aircraft have made far more landings with ***hytrol*** *than any other anti-skid braking system.*

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BOEING 720
CONVAIR 880
CONVAIR 600
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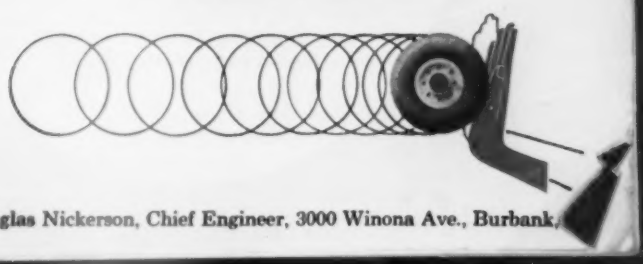
Developers and producers of reliable control components, sub-systems and systems for the aircraft, missile, electronics and transportation industries.

Write for descriptive literature on hytrol



ENGINEERS **Interesting opportunities are available. Write or call Mr. Douglas Nickerson, Chief Engineer, 3000 Winona Ave., Burbank,**

GUIDANCE

Jam-proof Polaris inertial guidance, the most advanced existing system of its kind—*compact* to fit a submarine launched missile; *rugged* to withstand the shocks of water, air and space; *accurate* to place the streaking Polaris on trajectory for its distant target; *reliable* to achieve consistently fine performance in the highly successful Polaris Flight Test Program; *produced* by General Electric's Ordnance Department.

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Versatile Polaris fire control, the equally advanced *partner* to inertial guidance—*accurate* in solving a most difficult weapon system problem, the aiming of ballistic missiles from a submerged moving platform; *precise*, compensating for the roll, pitch and yaw of the vessel; *dependable* for use on the long cruises of atomic submarines; *rapid* for firing sixteen missiles in as many minutes; *designed and produced* by General Electric's Ordnance Department.

Guidance and fire control systems delivered two years ahead of the original Polaris schedule.

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AVIATION CALENDAR

Oct. 10-12—Conference on Anatomy of Manned-Space Operations, American Rocket Society, Dayton Biltmore, Dayton, Ohio.

Oct. 10-12—1960 National Electronics Conference and Exhibition, Hotel Sherman, Chicago, Ill.

Oct. 10-14—Society of Automotive Engineers National Aeronautic Meeting, Ambassador Hotel, Los Angeles, Calif.

Oct. 10-14—82nd General Conference, National Guard Assn. of the U. S., Hawaiian Village Hotel, Honolulu, Hawaii.

Oct. 11-12—Fall Meeting, Institute of Printed Circuits, Sheraton Towers Hotel, Chicago, Ill.

Oct. 12-14—Third AFOSR Astronautics Symposium, Ambassador Hotel, Los Angeles, Calif. Sponsors: Air Force Office of Scientific Research; Society of Automotive Engineers (open meeting).

Oct. 12-14—Seventh National Symposium, American Vacuum Society, Cleveland-Sheraton Hotel, Cleveland, Ohio.

Oct. 14-15—Symposium on High-Speed Processing, Society of Photographic Scientists & Engineers, Washington, D. C.

Oct. 14-15—15th Midwest Conference, American Society for Quality Control, Broadview Hotel, Wichita, Kan.

Oct. 15-16—Fort Rucker Fly-In. For information: Commanding Officer, 2nd Battle Group, 31st Infantry, Fort Rucker.

Oct. 16-19—Mid-Year Conference, Airport Operators Council, San Francisco.

Oct. 17-18—Joint Meeting, Institute of the Aeronautical Sciences and Canadian Aeronautical Institute, Queen Elizabeth Hotel, Montreal, Canada.

Oct. 17-21—National Safety Council's 48th National Safety Congress, Conrad Hilton Hotel, Chicago, Ill.

(Continued on page 6)

AVIATION WEEK and Space Technology

October 3, 1960

Vol. 73, No. 14

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Engineering notes from the **SM/I REPORTER**

BY STANLEY M. INGERSOLL, *Capabilities Engineer*

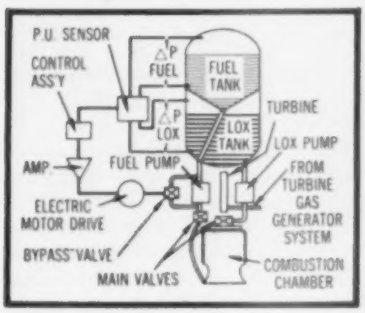
Report No. 10

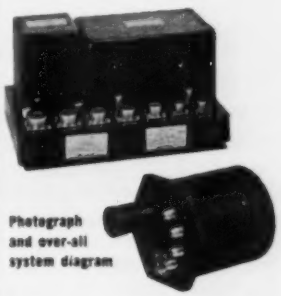
AQC 600 Propellant Utilization Control System

For maximum efficiency from a liquid propellant missile, fuel and oxidizer must be depleted simultaneously. Our new AQC 600 system, which consists of a controller and a differential pressure ratio sensor, measures the pressure ratio of fuel and liquid oxygen remaining in the tanks of a missile at any given time – then accurately controls the flow of these propellants into the combustion chamber. The percentage of accuracy is based on the propellants remaining in each tank, not on the full scale quantity. This reduces the absolute error signal as the propellant levels are decreased. The SM/I system measures the liquid head of each propellant and computes the ratio between the two head pressures electromechanically. An amplified error signal actuates a valve that changes the relative flow between fuel and liquid oxygen until the error signal is reduced to zero.

Typical Performance Specifications

Pressure Conditions		
Max. line pressure	120 psig	
Max. differential pressure	35 psid	
Min. differential pressure	0.2 psid	
Ambient	0-15 psi	
Gaseous medium	Gox, Helium, N_2, Air or H_2	
Electrical		
Input	115 volts, 400 cps, 10W	
	28 VDC – 1 amp.	
Heater Voltage (used only below 35°F)	28 VDC – 30 watts	
Environment		
Vibration	10-38 cps ±20 g's	
	38-2000 cps ±20 g's	
Shock	30 g's	
Acceleration	15 g's (one axis)	
Accuracy (on basis of ratio)		
Sensor ..... ±0.5%	Computer... ±0.15%	
Weight		
Sensor ..... 3.8 lb	Controller... 4.8 lb	





Photograph and over-all system diagram

For more information and complete operating specifications, write or wire SM/I today. Address your inquiry to Stanley M. Ingersoll, Capabilities Engineer.

SM/I SERVOMECHANISMS/INC.

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Hawthorne, California

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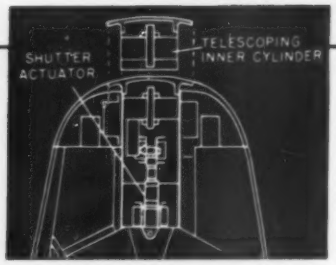

Detail of GE-built Nuclear Emulsion Recovery Vehicle (NERV) shows location of Airborne actuator used to extend and retract emulsion package. Requirements call for operation at temperatures from −65 to 160°F; altitudes to 200 miles and beyond. Weight of actuator: 1.2 lb.

Among the more critical of recent Airborne actuator applications is that on the National Aeronautics and Space Administration's NERV vehicle, where a linear actuator is required to extend and retract a nuclear emulsion package. In fact, success of the vehicle's mission—study of the lower Van Allen radiation belt—depends to no little extent on reliable functioning of this one component alone.

In initial firings, the 75-lb. NERV will be carried to an 800-mile altitude by Argo D-8 rockets. The flight program calls for energizing the actuator at 120 miles up, thereby opening the shutter and telescoping the emulsion package out from the front of the nose cone. This condition is maintained until the vehicle is within 200 miles of the ground on the way down, at which point the actuator retracts the emulsion package, closing the shutter.

Noteworthy also in this application are some of the prime contractor's quality assurance tests, including acceleration to 125 g; sound pressure level of 160 decibels minimum; and shock loading of 50 g.

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AVIATION CALENDAR

(*Continued from page 5*)

Oct. 19-21—Annual Convention, Southeastern Airport Managers' Assn., Far Horizons Motel, Sarasota-Bradenton, Fla.

Oct. 19-21—Symposium on Space Navigation, Institute of Radio Engineers, Deshler-Hilton Hotel, Columbus, Ohio.

Oct. 19-21—Annual Meeting, Society for Experimental Stress Analysis, Hotel Claremont, Berkeley, Calif.

Oct. 20-21—National Symposium on Hypervelocity Techniques, Institute of the Aeronautical Sciences, Shirley-Savoy Hotel, Denver, Colo.

Oct. 24-26—Medical and Biological Aspects of the Energies of Space, Unclassified Symposium, Granada Hotel, San Antonio, Tex. Sponsored by the School of Aviation Medicine. Arranged by Southwest Research Institute.

Oct. 24-26—Seventh East Coast Conference on Aeronautical and Navigational Electronics, Institute of Radio Engineers, Lord Baltimore Hotel, Baltimore, Md.

Oct. 25-27—11th National Conference on Standards, Sheraton-Atlantic Hotel, N.Y.C.

Oct. 27-28—1960 Annual Electron Devices Meeting, Institute of Radio Engineers, Hotel Shoreham, Washington, D. C.

Oct. 27-29—1960 Industry Display, Aircraft Electrical Society, Pan Pacific Auditorium, Los Angeles, Calif.

Nov. 1-2—Fall Meeting, Radio Technical Commission for Aeronautics, Sheraton-Park Hotel, Washington, D. C.

Nov. 2-4—Tenth Aircraft Hydraulics Conference, Pick-Fort Shelby Hotel, Detroit, Mich., Sponsor: Vickers, Inc., division of Sperry Rand Corp. (Invitational.)

Nov. 3-4—Annual Fall Meeting, Northeast Chapter-American Assn. of Airport Executives, Sheraton Inn, Binghamton, N. Y.

Nov. 14-15—Quarterly Regional Meeting, Assn. of Local Transport Airlines, Olympic Hotel, Seattle, Wash.

Nov. 14-16—National Convention, National Aeronautics Assn., Indio, Calif.

Nov. 14-18—Flight Safety Foundation's 13th Annual International Air Safety Seminar, in cooperation with Aviation Crash Injury Research, Phoenix, Ariz. For FSF members and by invitation.

Nov. 15-16—Symposium on Engineering Application of Probability and Random Function Theory, Purdue University, Lafayette, Ind.

Nov. 15-16—12th Annual Mid-America Electronics Conference, Institute of Radio Engineers, Hotel Muehlebach, Kansas City, Mo.

Nov. 15-17—36th Meeting, Aviation Distributors and Manufacturers Assn., Riviera Hotel, Palm Springs, Calif.

Nov. 15-17—Air Force-Navy-Industry Propulsion Systems Lubricants Conference (unclassified), Hilton Hotel, San Antonio, Tex. Cosponsors: ARDC's Wright Air Development Division; Southwest Research Institute.

Dec. 5-8—15th Annual Meeting and Astronautical Exposition, American Rocket Society, Shoreham Hotel, Washington, D. C.

Mar. 16-18—Fifth National Conference on Aviation Education, Mayflower Hotel, Washington, D. C.

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вычислительные машины

способствуют исследова-

нию языков

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ABSTRACTING

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Many hundreds of syntactic and semantic rules are used to remove ambiguities otherwise present in word-for-word translation. The considerable improvements that have been effected during the progress of this work indicate that it may be possible within the next year or so to produce, for the first time, machine translation of sufficient accuracy and at sufficiently low cost to justify practical application. Electronic computers are also invaluable for other language research activities at Ramo-Wooldridge.

Techniques for automatic indexing, automatic abstracting, and other aspects of communicating scientific information are also being investigated. Research and development at the Intellectronics Laboratories will eventually lead to electronic machines capable of carrying on self-directed programs of research and analysis and "learning" by their own experiences.

The accelerating pace at which these "communication of knowledge" problems are growing in importance has created challenging career opportunities in new fields of scientific endeavor.

For a copy of our career brochure, "An Introduction to Ramo-Wooldridge," write to Technical Staff Development.

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Mr. S. E. Miller, Vice President and Division Manager of American Bosch Arma, shows the hundreds of items which go into the manufacture of a fuel injection pump (upper left of table).

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These additional savings are expected from methods now in use:

■ sharp reduction of machine setup costs. ■ standardized production levels, to minimize manpower fluctuations and concentrate inventory dollars on active sales items. ■ substantial time reduction in production schedule changes. ■ automation of annual standard cost revisions, with a 70% expense cut.

When the Management Operation System is extended to other areas, American Bosch estimates that savings will be tripled.

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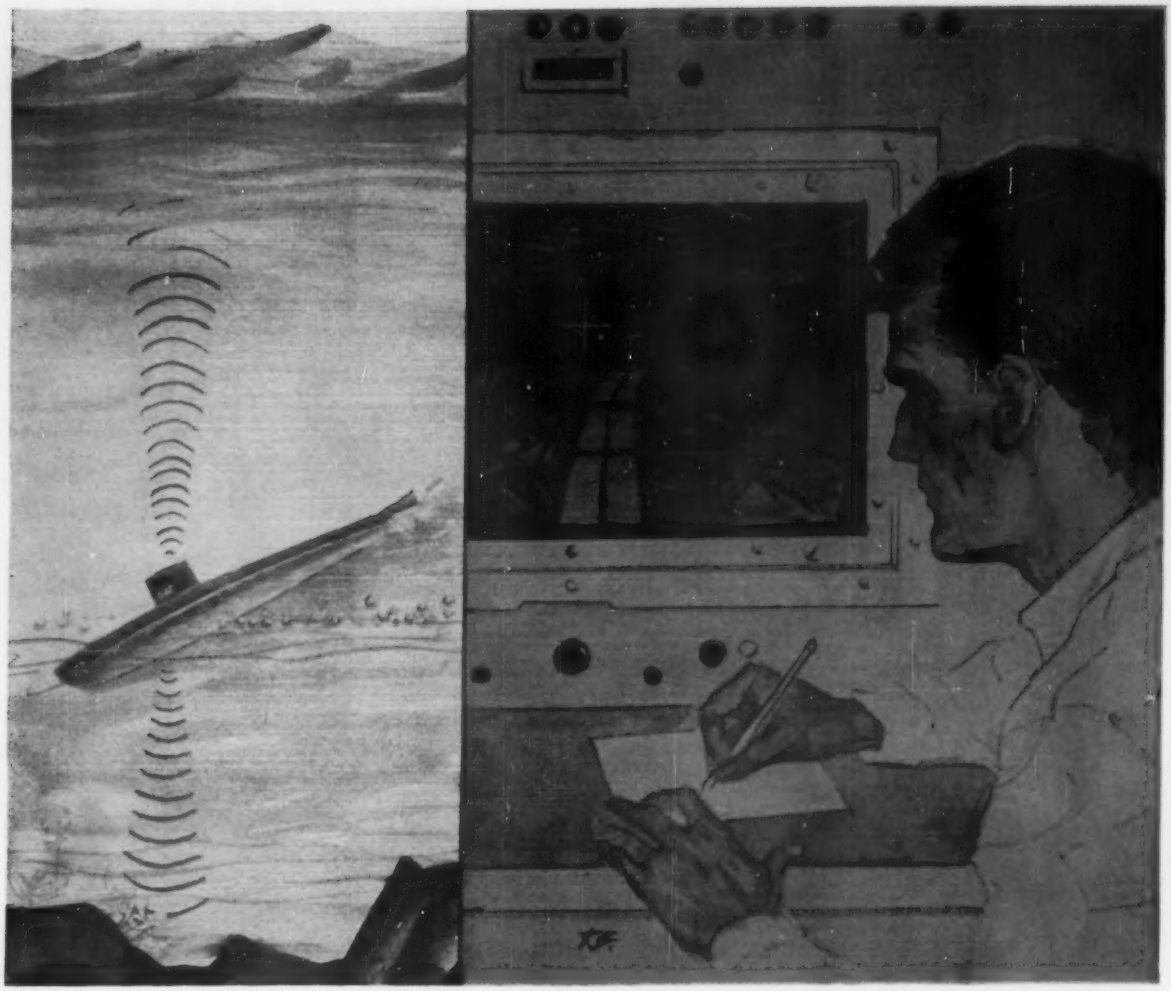

Norden Contact Analog Display... man's sight beneath the sea

A recent and significant Norden achievement is a contact analog display which orients man in the unnatural environment beneath the sea. This compact system provides a pictorial pathway for a submarine, displaying on a single screen all pertinent parameters: pitch, roll, heading, speed, surface and bottom positions. It forms an integrated control station for the craft. A sophisticated electronic system utilizing advanced television and computer techniques, it was developed for the Bureau of Ships and brought from concept to hardware in less than 18 months.

This is just one of several key programs at Norden involving advanced television, radar, digital computing and digital control systems. And as man continues to probe his universe, Norden engineers will be helping to make his craft safer and more efficient . . . for Norden is dedicated to extending man's capabilities.

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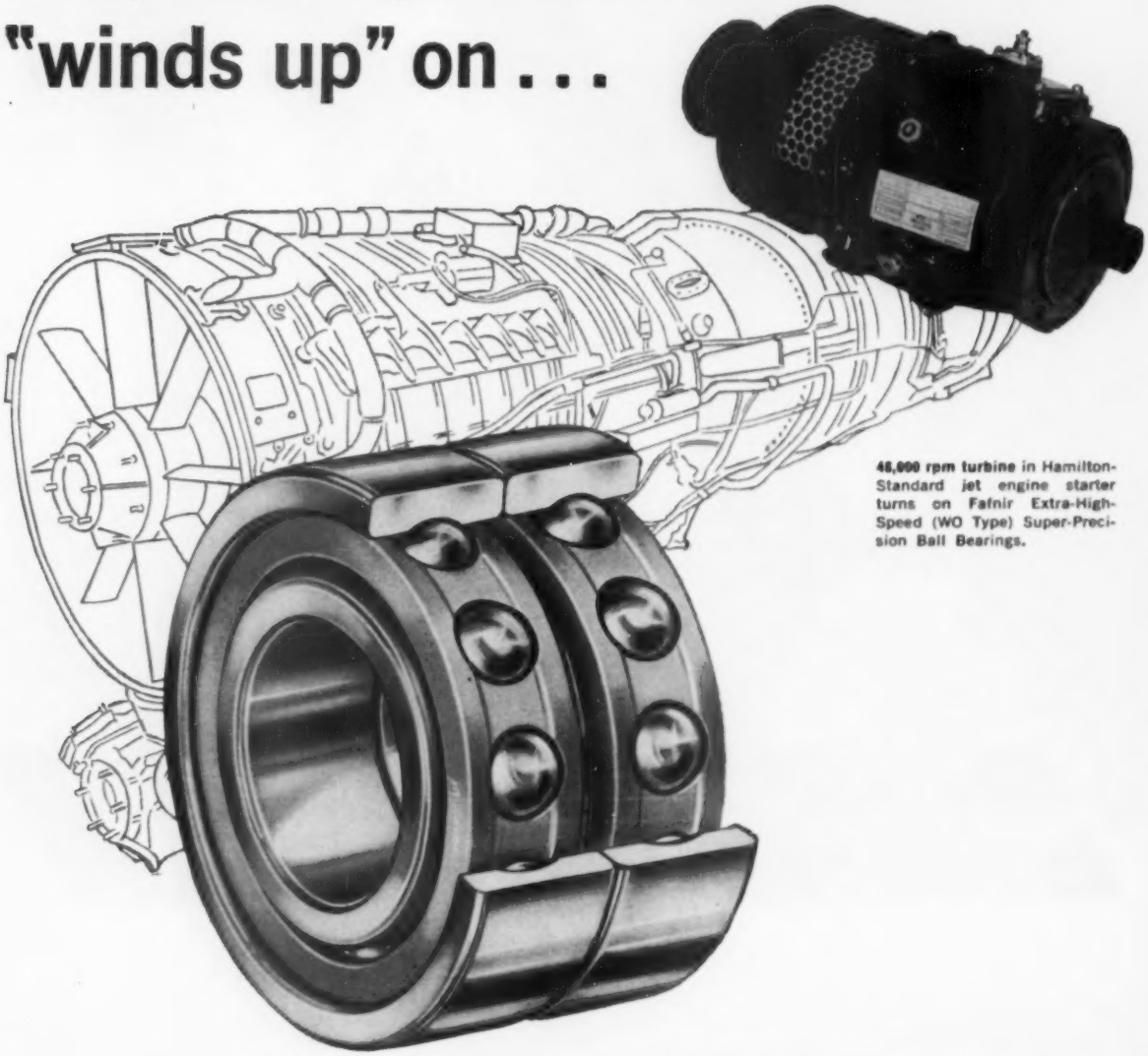

46,000 rpm turbine in Hamilton-Standard jet engine starter turns on Fafnir Extra-High-Speed (WO Type) Super-Precision Ball Bearings.

FAFNIR BALL BEARINGS

On the turbine end of Hamilton-Standard's PS400-14 jet engine starter, Fafnir Super-Precision Ball Bearings hold the turbine steady at 46,000 rpm speeds. The bearings themselves are engineered to meet testing speeds of up to 84,000 rpm!

From the moment the starter is energized, these extra-high-speed ball bearings are subjected to punishing service. Designed with "counterbored" inner rings for efficient high-speed performance, they must operate dependably and precisely under thrust loads of up to 350 pounds per bearing.

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FAFNIR
BALL BEARINGS

For more than a quarter century, Hallicrafters has worked in close partnership with our armed forces on fast solutions to critical military electronics problems. Out of this priceless experience are emerging startling new ideas and hard-hitting, fast-moving techniques to keep our country one jump ahead in electronic warfare . . .

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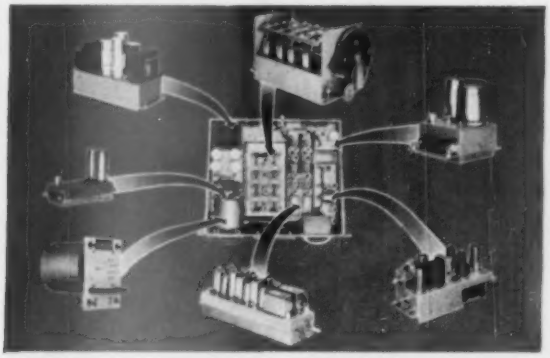
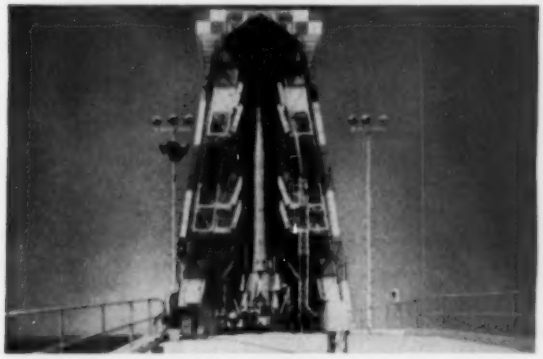
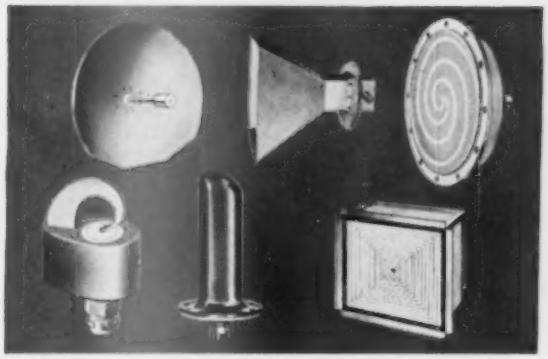


Hallicrafters communications leadership is exemplified by new high frequency Single Sideband receiver, (model no. SX-116). 100% modular design permits simple modification for compatability with existing and future communications systems. Stability, with proper available plug-ins, is better than one part in 10,000,000 per month. Hallicrafters also offers an existing capability in receiving and transmitting techniques up to frequencies of 50,000 megacycles.



Hallicrafters participation in the Atlas missile project helped to develop capability for many areas of the complex missile field, including code translator data systems; ground support equipment; ECM testing and antenna systems. Current explorations involve latest Infra Red techniques.



Airborne antennas and micro-wave components with power capability in excess of 1,000 watts, can be made available to solve tomorrow's very high power handling requirements. Testing of microwave components is possible with special high power generators, designed and built by Hallicrafters.

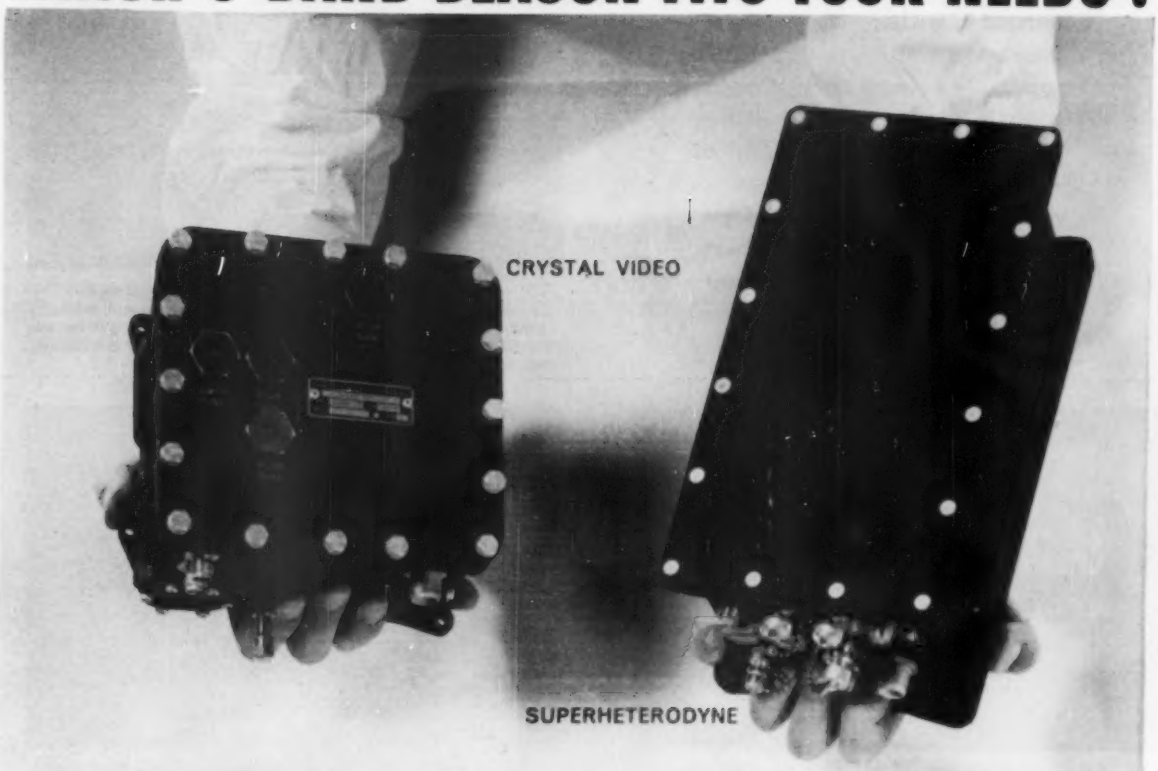
Looking for a challenging new opportunity? We are interested in qualified engineers at all levels. For full details in confidence, contact William F. Frankart, Director of Engineering.

For further information on Hallicrafters facilities and experience in military electronics research, development and production, please write to:

hallicrafters company

Military Electronics Division,
Chicago 24, Illinois

WHICH C-BAND BEACON FITS YOUR NEEDS?



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Flight tested, off-the-shelf delivery. Both beacons have been flight tested and successfully operated at theoretical line-of-sight ranges to 60,000 feet. Lightweight, compact and rugged enough to operate under extreme field conditions, the aluminum alloy casting packages are pressurized, designed for hard mounting to the airframe. Accessible parts and readily available adjustments insure easy service. Both beacons are completely transistorized throughout, except for the magnetron and local oscillator.

Compatibility Vought Electronics beacons are designed to be compatible with existing C-Band radars (FPS-16, MPS-26, etc.) and with primary power and antennas available on modern aircraft.

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A-L ANSWERS YOUR QUESTIONS ON VACUUM MELTED STEELS AND ALLOYS

Q. Where are vacuum melted alloys best suited?

A. For exacting applications—including materials for rockets, missiles, and jet engines. And other places where expensive machined parts are involved. In highly stressed parts where failure is highly costly. Where increased reliability is vital.

Q. What are the advantages of A-L vacuum melted alloys?

A. You get parts with optimum quality for critical applications—higher mechanical properties, better fatigue strength, improved toughness, and better transverse ductility. You also get maximum insurance against internal defects through improved cleanliness and decreased gas content. And hot and cold workability are improved, the material is more homogeneous, and properties are better.

Q. How are these metals made?

A. A-L uses all three of the vacuum melting processes. Consumable electrode vacuum arc remelting is used to produce A-L Consutrode® steels and alloys in ingots up to 20,000 pounds in weight. Induction vacuum melting is used to produce 2,000 pound heats of Allegheny Ludlum Invac materials. And remelting Invac electrode stock by the consumable electrode process produces A-L Invacutrode steels and alloys that have the best possible combination of chemistry control, cleanliness, and homogeneity.

Q. Specifically, what metals are available in A-L's premium quality melting?

A. Most of the steels and special alloys—low alloy steels, bearing steels, stainless steels, tool and die steels, and high temperature steels and alloys.

Q. In what forms are these A-L special steels available?

A. In all commercial mill forms—plates, sheet, strip, billet, bar, wire, tubes, and even extrusions.

Q. How do these vacuum melted alloys compare in cost with ordinary alloys?

A. Naturally vacuum melting costs more. Consutrode alloys are the least expensive, followed by Invac alloys and Invacutrode alloys. Their use is economically justified by the improvement of quality in the finished part, the quality required by the severity of the manufacturing process involved, and the increase in the yield of sound parts.

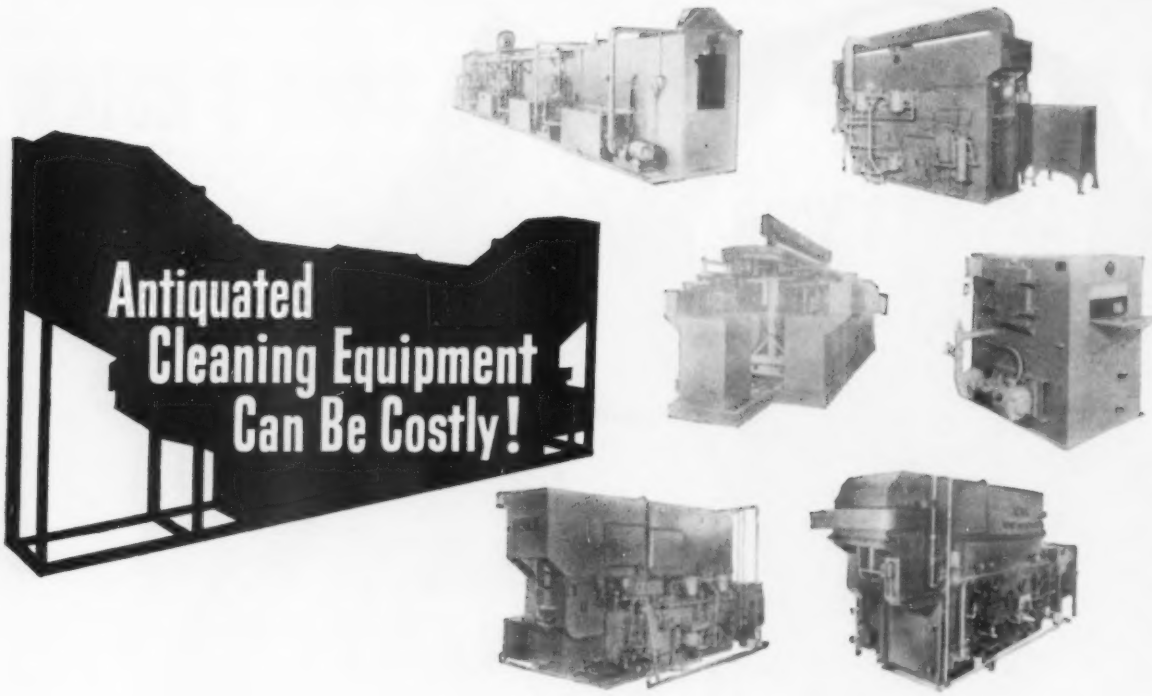
Q. Where can I get more information?

A. Ask your A-L representative for your copy of "Modern Melting at Allegheny Ludlum." It gives technical data on the new melting techniques and quality improvements in materials. Or write: ***Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pennsylvania. Address Dept. AW-10.***

ALLEGHENY LUDLUM AL

PIONEERING on the Horizons of Steel

2256



Detrex will lease a machine to fit your needs exactly and economically!

It is no accident that the Detrex nameplate is found on more cleaning equipment in more metal-working plants than any other—*by a wide margin.* Detrex has had more than 30 years' experience in designing this equipment—has the most complete and modern facilities for producing it—has the largest and most expert field force to help install and service it. And now you can lease any of your cleaning equipment requirements from Detrex. Whether you need a machine for degreasing, washing, rustproofing, phosphate coating, paint-bonding or paint stripping—whether you require equipment that is large or small—whether you desire a manual or automated operation—Detrex can supply your needs exactly and follow through with the service that means complete satisfaction.

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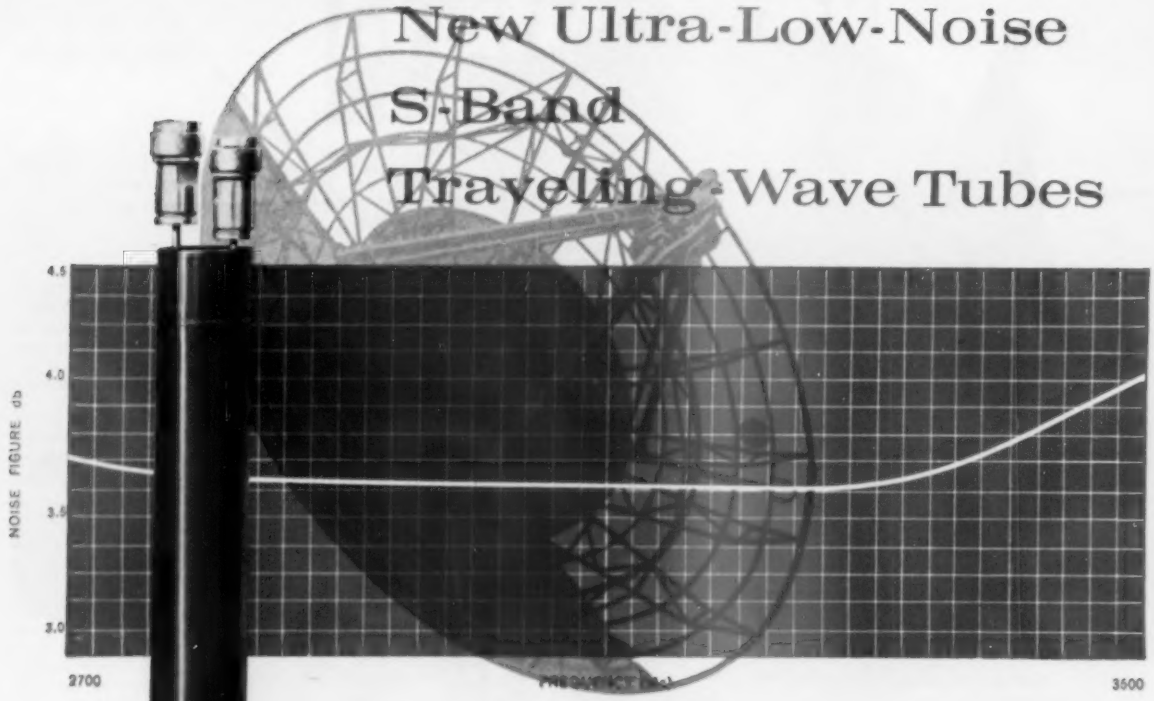
World's Largest Exclusive Producer of Cleaning Chemicals and Equipment

From RCA's microwave designers

New Ultra-Low-Noise S-Band Traveling-Wave Tubes



With a Terminal Noise Figure as Low as 2.8 db.

Here are the dramatic facts about the new RCA developmental type A-1207 series of Ultra-Low-Noise Traveling-Wave Tubes.

4.5 db Maximum Terminal Noise Figure. This is a realistic value of noise figure because it includes coupler losses. Because this is a maximum value, the average noise figure for tubes in this series is considerably less than 4.5 db. Laboratory tests of tubes of this series have shown terminal noise-figure values as low as 2.8 db.

Advanced Proven Design. The design of the developmental type A-1207 series is based on that of the well known RCA-6861. Only recently Zurich Airport reported 19,200 hours of service from a 6861.

Complete S-Band Coverage. The developmental type A-1207 series offers coverage in bandwidths of 200 Mc to 800 Mc for S-band frequencies between 2200 Mc and 4100 Mc.

1 Milliwatt Minimum Power Output. You'll obtain an output of over 1 milliwatt with a minimum gain of 20 db from any tube in this remarkable series.

Most important of all, the RCA developmental type A-1207 series is a firm design, ready for immediate production and delivery to meet your schedules. Get full details about this unusual new line of ultra-low-noise traveling-wave tubes today. Contact the RCA Field Office nearest you. RCA Electron Tube Division, Harrison, N. J.

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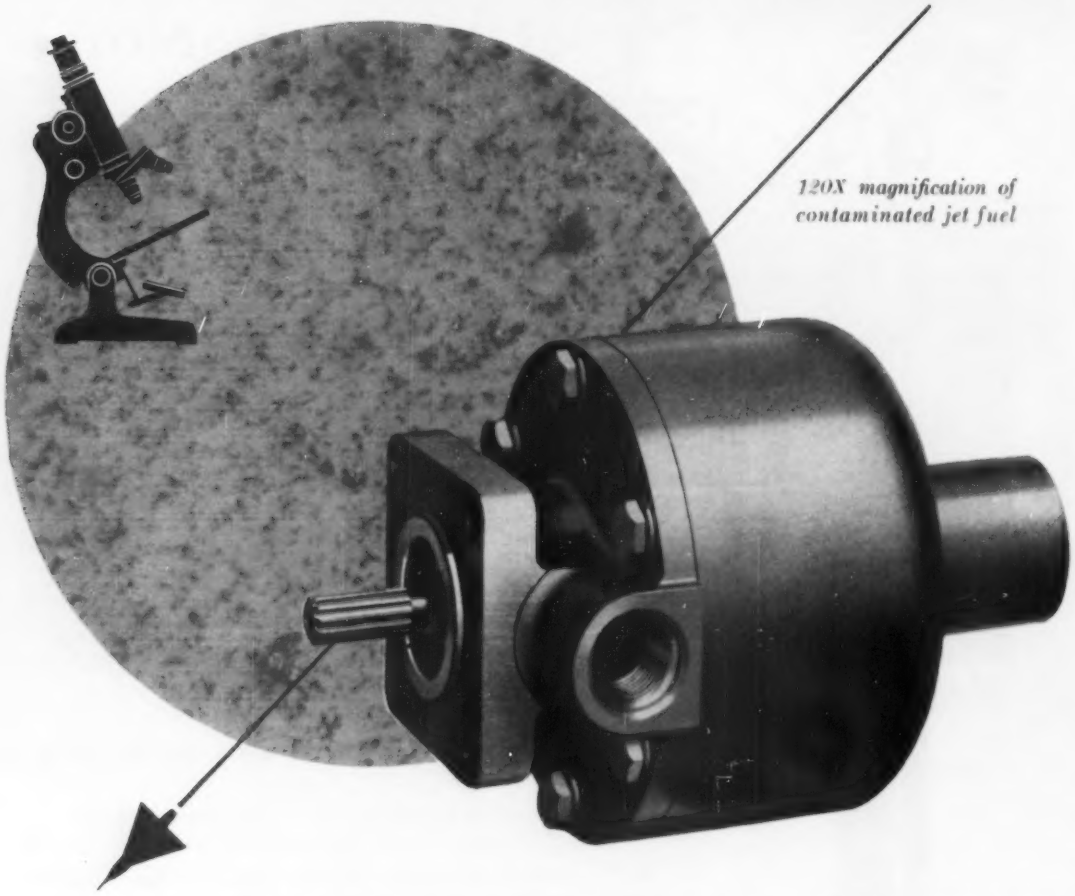
NEW VANE-TYPE FUEL PUMP



. . . . Gives longer service life when pumping contaminated jet engine fuels at high volumes and pressures

Vickers balanced-vane type jet engine fuel pumps designed to meet stringent MIL-E-5009B and MIL-E-8595 contaminant tolerance requirements are available in a size range of 500 to 50,000 PPH, develop up to 1000 psi and operate at speeds up to 6000 rpm. Pumps can be provided for speeds as high as 20,000 rpm and pressures above 1500 psi, where required. The housing configuration is adapted to specific installations.

Model shown has these performance characteristics: Pressure—to 1000 psi; flow—4000 PPH, speed—4000 RPM; temperature range—65° to 300° F, weight—5 lbs, size—$4\frac{3}{32}$" dia., $5\frac{5}{8}$" long.

Designed for a service life of 1000 hours, the new Vickers vane pump was proved in more than 3400 hours of rigorous testing over the last two years (see Bulletin A-5242). Wear compensating parts and new material combinations extend service life.

Write for Bulletin A-5242 for more details.

AERO HYDRAULICS DIVISION
VICKERS INCORPORATED
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October 3, 1960

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▶ Jet transports have started shift in travel patterns; slowdown in traffic movements at Miami is marked example.

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▶ Major space technology companies investigate programs to provide capability for intercepting, destroying satellites.

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COVER: Convair's 880 jet transport, B-58 Hustler bomber and F-106 interceptor fly in formation over the Mojave Desert near Edwards AFB, Calif. Photograph was made from a two-place F-106 after completion of performance tests by the 880 and military tests by the B-58 at Edwards; the F-106 came from Convair's production test facility at Palmdale. The formation was flown at 350 kt.

PICTURE CREDITS

Cover—Dan H. Otto, Convair; 27, 54, 55—Aviation Week; 33—Grumman; 34—NASA; 38—USAF; 45—British Aircraft Corp.; 47—Boeing Airplane Co.; 79—Amcel Propulsion, Inc.; 82—Sikorsky; 85—Vertol; 87—Saunders-Roe; 88, 89—USAF; 97—Cessna; 99—W. L. Maxson Corp.

83,478 copies of this issue printed

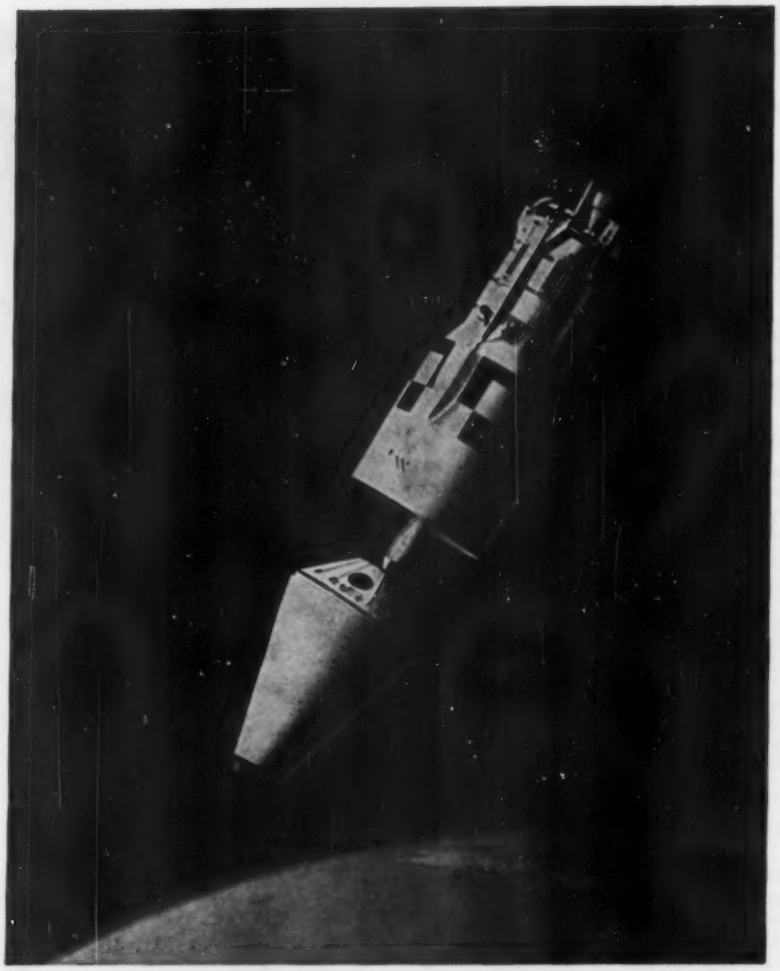
TO SPACE AND BACK!

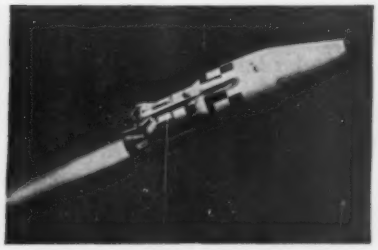
America's Agena is first orbiting satellite to send a capsule back from space

On August 11 a Lockheed-built Agena satellite gave America a monumental "first" in the race to conquer space. With perfect timing, it dropped its payload into a recovery area near Hawaii.

This brilliant feat, verifying the recovery technique, could not have been accomplished without the spadework already done by earlier Agenas in the Discoverer program of the U.S. Air Force. The Agena was first to be put on a predetermined orbit, a nearly circular orbit, and the difficult polar orbit; first to be commanded, monitored, and maneuvered on orbit; first to stabilize itself at an exact angle to earth; first to eject a recovery capsule. But the Discoverer program's most important achievement has been to provide the Air Force with a tested satellite for its vital Midas and Samos programs.

A larger, more powerful version, the Agena B, will be used in the satellite, lunar, and deep-space programs of the National Aeronautics and Space Administration for several years.



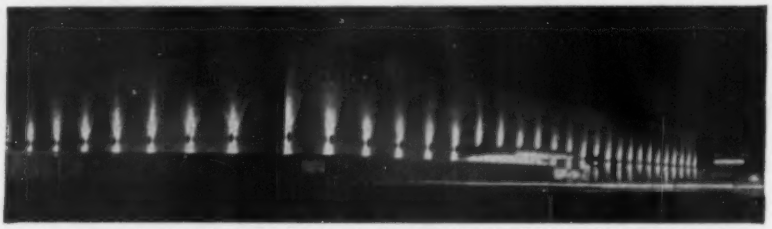


1. After first-stage Thor booster dropped away, Agena satellite's own rocket engine ignited and drove it to exact speed to reach its planned polar orbit.

2. As soon as it reached its orbit, the Agena satellite swung itself around 180°, so that it sped tail first on its 18,000-mph, 94-minute journey around the world.

3. During the Agena's 17th pass around the earth, a timing device triggered gas jets that tilted its nose downward to a 60° angle for ejection of re-entry vehicle.

4. After the vehicle's retro-rocket (see main illustration) had slowed it to a safe re-entry speed, a parachute lowered the 300-pound capsule to recovery area.



5. Agenas are made at "Satellite Center, U.S.A."—headquarters of Lockheed's Missiles & Space Division at Sunnyvale, California. Lockheed is prime contractor for the Discoverer program. Subcontractors are the General Electric Co. (recovery capsule), Bell Aircraft Corp. (Agena engine), and Douglas Aircraft Co. (Thor booster).

LOCKHEED

MISSILES & SPACE DIVISION • SUNNYVALE, PALO ALTO, SANTA CRUZ, VAN NUYS, CALIFORNIA

EDITORIAL

Pity the Poor Passenger

A year of international jet travel to the Orient, Europe and South America plus transcontinental shuttles and domestic commuting convinces this air traveler that the jet age has left the fare-paying passenger even further down the airline totem pole when it comes to service, convenience and courtesy. True, the time compression of distance by the jet transports of U.S., French and British manufacture is nothing short of fantastic, and the full effects of this have yet to be felt. Major adjustments of working and playing habits are still required to properly utilize this new asset, and even airline schedule experts have not yet fully solved the problem of how to offer this time compression to the passenger for his maximum use.

But while the jet transports whisk through the air at from 500 to 600 mph., after a ground delay that makes timetables only a rough approximation, the passenger is taking a heavier beating than ever before at both ends of his flight. It also appears that in-flight passenger service is sliding down a decline into second rate restaurant service, but this becomes less important with the increased speed of the jets and the major slices in flight time. More and more, the airline traveler will be buying speed and regularity, not service in flight.

On the ground it is a different story. Here the passenger wants, needs and is entitled to some efficient handling of himself and his baggage, and it is here that the airlines are doing an increasingly ineffective job as their passenger volume rises. Baggage is perhaps the most serious annoyance, and you hear the new slogan of the jet age now at most any major airport:

"Breakfast in San Francisco, lunch in New York, dinner in London and baggage in Buenos Aires."

Baggage Handling Woes

Unfortunately, although I am sure the Air Transport Association can quote some soothing statistics on the percentage of baggage lost, this is too often true. Unless you have the reflexes of a hockey player and a canny knowledge of airline baggage whisking procedures, you may find it difficult to come up with your bags in the same place you happen to be at the moment. The baggage tagging procedure has become almost a farce. In a recent international swing through five countries using five airlines, not a single baggage claim check was ever required to retrieve luggage, and in most cases there were no porters to carry it if your personal muscular resources proved inadequate.

The Idlewild terminal complex may be fine for a well-trained miler carrying only an extra handkerchief, but for international travelers with any quantity of luggage, making a connection becomes a nightmare. London Airport and Idlewild are apparently still vying to see which can maintain a woodshed terminal for transatlantic passengers the longest, with even an experienced commuter now unable to distinguish which transatlantic terminal is the least fit for human habitation.

It is high time to launch a campaign against the ubiquitous airport head tax and the policy of operating an airport like a pay toilet instead of a universal service facility. In view of the increasing revenue deposited in each local economy by the growing volume of tourist traffic, this airport head tax is an outrage and airline passengers should begin to apply pressure to local governments to get rid of it.

Some progress has been made in reducing the paper work required of the international airline traveler, but Britain has now come up with a new policy designed to repeal this progress and require even longer statistics from each passenger to and from the United Kingdom.

Ticket Counter Bottleneck

The airline ticket counter has now become a bottleneck that defies anybody making close connections to catch a flight. There is nothing more exasperating when you are trying to check in for a flight the standard 20 min. prior to departure than to be caught behind two maiden schoolteachers planning a three month itinerary around Europe. We know many airlines have made various efforts to separate those checking in for current flights from the long term planners, but we have yet to see any of these systems work effectively. With the possibilities of more than a hundred passengers on each jet flight, the ticket counter bottleneck is getting worse, not better. Airline ticketing procedures still haven't progressed much beyond the goose quill pen. True, there are some enlightened airlines that are providing simple automatic ticketing procedures, and these are earning the fervent blessings of the harassed air traveler. But the amount of laborious handwriting that still goes on the majority of airline tickets is simply ridiculous.

The jets have given the airlines the opportunity to serve more people than ever before and make a more significant contribution to the international pattern of working and playing than ever before. But it is sad to note that while airlines' revenues are rising fast, their expenses are rising even faster. We suspect that streamlining many of the complicated procedures that now annoy passengers so consistently would also reduce the swelling in airline overhead expenses. Certainly the full utility of the jet age for the traveling public and the full financial flowering of this era for the airlines and their investors will not be realized until they learn how to handle the increasing passenger volume faster, cheaper and with far less friction.

In our recent safari we noted that the air terminal bars all worked well. And this is indeed a blessing, because after being ground through the airline passenger handling system, medication is urgently required.

—Robert Hotz

The sky's no longer the limit

Recovery of the first space capsules from orbit demonstrates the effectiveness of protection against the searing heat of satellite re-entry. Heat shields, produced by a special B.F.Goodrich process, protect the re-entry/recovery vehicles of all Discoverer satellites launched to date. Produced under sub-contract to General Electric, each shield withstands tremendous pressures, and "ablates" to keep heat from damaging the instrumented capsule. BFG experience in this field further includes heat shields fabricated for USAF Thor-Able and Atlas missile re-entry vehicles, and for the model of the Project Mercury capsule. In this, and many other advanced areas, B.F.Goodrich is ready for duty on your space-age team.

Air Force Discoverer heat shield was supplied to General Electric Missile and Space Vehicle Department, who developed and built the complete re-entry/recovery vehicle (on right) under subcontract to Lockheed Missile and Space Division.

B.F.Goodrich

B.F.Goodrich aviation products

WHO'S WHERE

In the Front Office

Dr. Frederick E. Bond, president, and **Harold F. Meyer,** executive vice president, Ryan Communications, Inc., Canoga Park, Calif., newly formed subsidiary of Ryan Aeronautical Co.

Stuart E. Weaver and **Harry B. Horne,** vice presidents, The Marquardt Corp., Van Nuys, Calif. Mr. Weaver will assume responsibilities for marketing; Mr. Horne continues as director of corporate planning.

Dr. Donald G. Wilson, vice president-research, P. R. Mallory & Co., Inc., Indianapolis, Ind.

H. A. Doolittle, vice president and general manager, Stimsonite Division, Elastic Stop Nut Corporation of America, Chicago, Ill., and **Glenn W. Johnson,** vice president and general manager of the company's Elizabeth Division, Elizabeth, N. J.

Lawrence Hermes, president, International Communications Corp., Santa Monica, Calif., a subsidiary of Applied Electronics Corporation of New Jersey.

Harold F. Wiley, a vice president, Consolidated Electrodynamics Corp., Pasadena, Calif. Mr. Wiley continues as director of the Analytical & Control Division.

R. L. Frederick, vice president in charge of International Divisions, The Timken Roller Bearing Co., Canton, Ohio, and **R. A. Gulling,** controller of the company.

J. Gordon Neuberth, vice president and chief engineer, Applied Microwave Electronics, Inc., Baltimore, Md.

Col. David M. Jones, vice commander, USAF's Wright Air Development Division, Wright-Patterson AFB, Ohio, succeeding **Col. William Grohs,** retiring.

Maj. Gen. D. E. Hooks, commander, Air Force Research Division, replacing **Maj. Gen. W. M. Canterbury,** who takes Gen. Hooks' former assignment as commander, Air Force Missile Development Center, Holloman AFB, N. M. Also: **Brig. Gen. B. G. Holzman,** commander, Air Force Cambridge Research Laboratories.

Honors and Elections

Electronic Industries Assn., Washington, D. C., has named **Trevor Clark** as chairman of the Military Equipment Panel of EIA's engineering committees on development of military specifications and standards and allied problems. Mr. Clark is assistant to the engineering manager of the Air Arm Division of Westinghouse Electric Corp. Named chairman of two panel committees: **Dr. A. L. Floyd** of Hoffman Electronics Corp.'s Laboratory Division, as head of the Military Components Engineering Coordination Committee; **H. R. Dyson** of Radio Corporation of America, as head of Military Equipment Specifications.

Dr. Elliot T. Benedikt, head of the Space Physics Laboratory of Northrop's Norair Division, has been elected chairman of the Space Physics Committee of the American Astronautical Society.

The Bell Helicopter Pioneer Award has been presented to **British European Airways** in recognition of BEA's 13 years of helicopter operations.

(Continued on page 104)

INDUSTRY OBSERVER

► Two of 11 companies invited by USAF to bid on the Samos E-6 reconnaissance satellite capsule (AW Sept. 19, p. 26) have dropped out of the competition, but a number of others see it as an excellent chance to get into a military space vehicle market now largely dominated by Lockheed, which has Discoverer, Midas and Samos programs. E-6 competition will provide second-source research and development, design and production in the Samos program.

► **Cornell Aeronautical Laboratory pilots are checking out an Air Force team which will fly CAL's variable stability Lockheed T-33 from the Flight Test Center, Edwards AFB, Calif., to simulate re-entry conditions of the North American X-15 and Boeing Dyna-Soar. Flights will simulate handling characteristics in the transition from orbital to atmospheric flight.**

► Brooklyn Polytechnic Institute scientist has discovered that radio signals received from distant stations at different geographic locations develop individualized characteristics in transit that make it possible to determine transmitter location without using direction-finding techniques. Discovery, which resulted from studies of automatic pattern recognition, is sponsored by USAF's Astrosurveillance Science Laboratory.

► **First Vertol YHC-1B twin-turbine Chinook helicopter now is expected to roll out next January, somewhat behind the original November target date (AW Feb. 15, p. 120). Tiedown flights are planned for March after completion of usual ground running program.**

► Space Electronics Corp. is studying simultaneous multiple image correlation (Simicore) under contracts with Wright Air Development Division and Avco's Research and Development Division. Possible applications include interpretation of radar images and terminal guidance for ICBMs. Development emphasizes high-volume information storage capability in small package.

► **Major improvements in vector and thrust control of solid-fueled rockets are believed possible through use of plug nozzle engines. Several firms are investigating use of control petals on the plug itself. These would be extended symmetrically for thrust control and unsymmetrically for vector control.**

► USAF-North American Hound Dog air-to-ground missile, carried by the Boeing B-52, is undergoing study to determine feasibility of mounting another type of weapon under each of Hound Dog's wings to make it a triple-punch system.

► **Marine Corps will take a second look at prospective replacements for its Sikorsky HUS-1 light assault helicopter in about two months, re-evaluating Sikorsky's HR3S against Vertol's 107 Model II utility machine. Both paper and actual flight missions will be compared.**

► Internally implanted biological telemetry system is being developed by North American Aviation under USAF contract.

► **Longtime perturbation in the attitude stabilization of Tiros I weather satellite is believed to be caused by interaction between earth's magnetic field and stray fields produced by the satellite's avionic payload. Tiros II will carry a ground controlled magnetic dipole with which magnetic fields can be created to compensate for this perturbing interaction.**

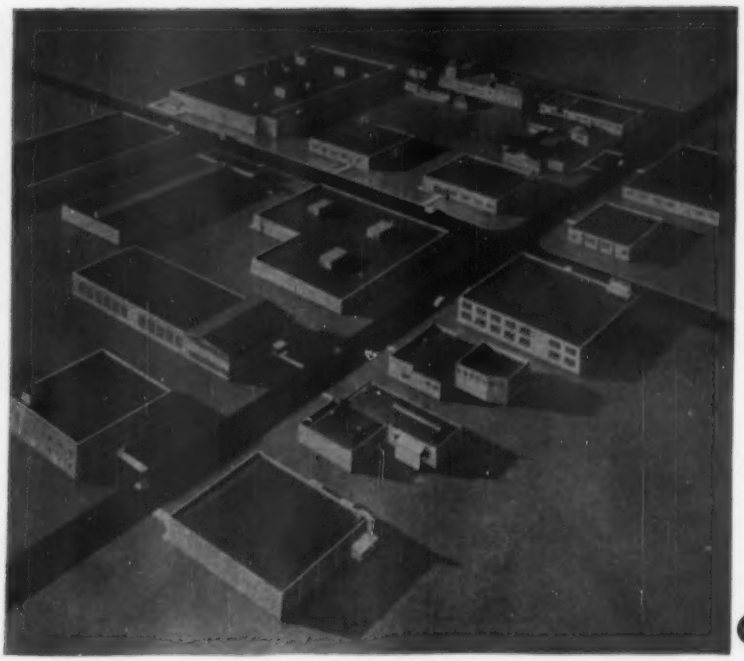
► Linde Division of Union Carbide is studying storability of cryogenic propellants for the USAF-Convair Atlas ICBM under sponsorship of Air Force's Ballistic Missile Division.

► **Russia's All-Union Institute of Scientific and Technical Information, which claims to be the world's largest information center, currently is preparing more than 600,000 abstracts of papers published by 90,000 sources in 65 languages from 95 countries.**

LIBRASCOPE COMPUTER FACILITIES

Shown below is a composite view of Librascope's facilities where a variety of computer systems are currently in different stages of design and production. Some are strategically involved with national defense...others deal with business and industrial process control. Each is uniquely designed to answer a particular need. The success of these systems illustrates the value of Librascope's engineering philosophy: A decentralized organization of specialized project teams responsible for assignments from concept to delivery...and backed up by excellent research, service, and production facilities. For your computer requirements, call on the company whose breadth of diversification in computer technology is unsurpassed. ■ Librascope Division, General Precision, Inc., 808 Western Avenue, Glendale, Calif. For career opportunities write to John Schmidt, Engineering Employment. ■

computers that pace man's expanding mind



GP

Washington Roundup

California Pressure

White House and the Pentagon have felt the backlash of the lull in commercial jet transport orders. California congressmen have been pressing the President and Air Force to spend MATS interim modernization money for C-133s or swing-tail DC-8s in order to keep Douglas Aircraft's Long Beach plant busy. They want military orders to fill the gap until airline DC-8 reorders, which Douglas expects, materialize.

President Eisenhower has been urged to throw business to Douglas-Long Beach in order to maintain industry competition. A letter signed by both California senators and five congressmen points out that Boeing, Lockheed, Douglas and Convair provide the major U. S. transport production capacity. It says Boeing and Lockheed already have substantial military transport business and that Douglas-Long Beach and its 18,000 employes should also be kept busy.

USAF Secretary James H. Douglas got a strong pitch from Rep. Craig Hosmer, the Republican representative from Long Beach, and Sen. Thomas H. Kuchel. Hosmer stressed airline financial problems as the cause for currently lagging DC-8 orders. He presented the plea of a "united front of labor, industry, community and government leaders" for a C-133 or DC-8 order.

Rep. Hosmer took a swing at USAF Vice Chief of Staff Gen. Curtis LeMay. He said LeMay, "who actually runs the Air Force," is interested only in ICBMs and SAC bombers and "could care less" about airlift and airframe industry problems. He also noted Convair's efforts "to grab the interim job," but implied Convair's interests are satisfied through the proposed deal to buy CL-44s from Canadair, a Convair associate in General Dynamics Corp.

Defense Secretary Thomas Gates has expressed sympathy with the Douglas situation, but he isn't buying the proposal. He points out that USAF needs a truly new transport, to be specified in Specific Operational Requirement 182, and present Boeing, Douglas and Convair transports don't fill the bill. For the interim role, Gates said the C-130E is preferred over the C-133 for the initial purchase. USAF hasn't yet decided what it will buy with the rest of the interim money.

Decision on SOR 182 contractor is expected before the end of the year. Gates observed that Douglas can compete for this contract and that, other factors being equal, economic factors are considered in awarding contracts. He also reminded the Californians that Douglas recently got a development contract for the Missileer aircraft that could lead to substantial production.

New York's continuing fight for more military contracts was supported by Democratic presidential candidate Sen. John Kennedy last week. Campaigning in New York state, he said contracts should be equitably distributed across the nation, especially where costs are lower or where there is substantial unemployment.

Scandinavian Stalemate

First major U.S. attempt to enforce traffic capacity restrictions on international routes failed last week. Bilateral negotiations between the U.S. and Scandinavian countries were terminated in a deadlock. Negotiators were too far apart on the capacity issue from the beginning to make further discussion worthwhile.

State Department has chosen the Scandinavian situation to launch a drive for capacity restrictions on all foreign carriers operating to U.S. points. Heavy pressure for the drive comes from U.S. flag airlines. The American argument is that traffic carried by Scandinavian Airlines System from the U.S. to points beyond Scandinavian cities isn't the type of primary traffic permitted to flow freely between the nations covered in the present bilateral. This distinction would make it subject to the same restrictions as Fifth Freedom traffic.

Scandinavians stoutly deny this. They are arguing that this traffic is not subject to control because it moves between the U.S. and Scandinavia, and it doesn't matter where it goes after that.

Scandinavians declared the negotiations finished. U.S. hopes to resume them after the two delegations have had a chance to confer with their governments. It is the capacity provisions, not the bilateral itself, that are currently at issue. But conceivably the rancor that may arise if State really pushes this test case could produce renunciation of the whole bilateral.

Congressional pressure is increasing on AEC to show replicas of the atomic bombs the B-29 Enola Gay dropped on Hiroshima and Nagasaki. House Government Information Subcommittee headed by Rep. John Moss has joined the campaign to get them released.

Atomic Energy Commission insists displaying the bomb models would be saber-rattling. Defense Department disagrees and would like to display the reproductions at armed forces exhibits. Enola Gay is being reconditioned for permanent display by the Smithsonian Institution.

—Washington Staff

Skybolt ALBM Gets Priority for 1964

New configuration of air-launched weapon resembles conventional ground-launched ballistic missile.

By Irving Stone

Santa Monica, Calif.—Douglas Skybolt air-launched ballistic missile will be capable of strike operation early in 1964 with the Air Force's Boeing B-52 and Britain's Avro Vulcan bombers, according to Air Research and Development Command and Strategic Air Command timetables.

The weapon is being advanced with the same high priority as other ballistic missiles and is being developed for its penetration potential to:

- **Permit the aircraft** to deliver nuclear warheads on target while cruising on station 1,000 naut mi. from the defensive forces around this target zone (AW Feb. 22, p. 27).
- **Knock out or soften** opposing resistance capability to allow the launching plane to follow in over the target for further damage infliction.

Variety of Payloads

It is almost certain that the development effort being put into the weapon system will justify accommodation of a variety of payloads—that it could not, either economically or strategically, be limited to a single warhead potential on the low side of the capability scale.

Because design change has removed the canard control surfaces from the second stage motor casing (AW June 6, p. 23), it is likely that the Skybolt configuration has now been set to resemble a conventional ground-launched ballistic missile configuration. Schematic representation of the first-stage rocket motor indicates that the nozzle is fixed, hence aerodynamic control of the missile from time of launch would be accomplished most simply by four control fins on the aft end. These surfaces, plus an equal number of fixed stability fins, would give a total of eight surfaces around the perimeter of the first-stage base. Probability is that the fin configuration, like that on the Air Force's Douglas Thor IRBM, is triangular, although other aerodynamic configurations could be adapted.

Removal of the canard surfaces from the second stage also indicates that second-phase control of the missile, once the first stage has been separated, will be by a gimbaling nozzle in the second stage.

Probability is that the re-entry portion of the missile (warhead) also will depend on the spin rockets to stabilize its impact trajectory.

All these features are in keeping with the basic development philosophy for the Skybolt—to freeze the design within state-of-the-art parameters, to ensure an operational availability which would give new value to the strategic bombing potential of the Air Force's B-52 and Britain's Vulcan aircraft. Original intention to fit the Skybolt to Britain's Handley Page Victor bomber was abandoned, according to British sources, because with the projected installation of the weapon under the Victor wing, the missile's star tracker would not be able to "see." Also, Douglas technical personnel admit that severe ground clearance problems existed in the Victor application, probably related to fin-ground interference. There are no difficult design changes to adapt the missile to the Vulcan.

If the approximate limit diameter—about 3 ft.—as seen by solid propellant technicians for this type of weapon holds true, then proportions of the schematic representation of the first-stage rocket motor indicate that the stage is about 150 in. long.

Scaling from this basic component to a shorter second-stage motor, followed by a guidance section and a structural fairing to the re-entry portion (warhead sheathed with a conventional ablative nose cone), missile engineers estimate that Skybolt's over-all length will be between 30 and 35 ft.

Navigation and guidance for the Skybolt weapon system ties in aircraft and missile components. Fundamentally, navigation and guidance equipment includes existing bombing and navigation systems in the aircraft, an aircraft-installed prelaunch computer, which is new equipment but based on existing techniques, and a guidance computer and an inertial guidance platform, both installed in the missile, and generally considered to be in the conventional equipment category.

The bombing and navigation system equipment provides initial conditions for the missile. This information is fed to the prelaunch computer which establishes initial conditions of velocity in three axes and feeds this information to the guidance computer in the missile, which imparts its computations to the inertial guidance platform.

Typical Trajectory

A typical trajectory sequence according to a schematic of the mission profile, would include these events:

- **Missile is released** for a short gravity drop.
- **First stage is ignited** and Skybolt streaks forward in a horizontal attitude
- **Pitch-up phase begins** almost immediately to put the missile into its powered climb. At this point, the missile's azimuth heading is corrected for a forward-direction trajectory or for an off-course (to the side) trajectory, if this is programed.

Skybolt Team

- Douglas Aircraft Co., Santa Monica—Prime contractor. Facilities participating include El Segundo, Tulsa, and Sacramento.
- Aerojet-General Corp.—Rocket motors.
- General Electric Co.—Re-entry vehicle.
- Northrop Corp.'s Nortronics Division—Guidance system.
- Boeing Airplane Co., Wichita Division—Associate contractor for USAF for various phases of aircraft/missile compatibility and test program.
- A. V. Roe—Associate contractor for Royal Air Force for various phases of aircraft/missile compatibility and test program.
- Bendix Support Equipment Division, Teterboro, N. J.—Automatic programing (checkout) set.
- Bell Aircraft Co., Buffalo—Accelerometers, as subcontractor to Nortronics.
- General Precision Corp.'s Kearfott Division, Little Falls, N. J.—Gyroscopes, as subcontractor to Nortronics.
- International Business Machine Corp., Owego, N. Y.—Analog-digital converter, as subcontractor to Douglas.
- Douglas, Nortronics, General Electric, Motorola, Inc.—Supplying various adapters for use in conjunction with Bendix checkout set.

Indians Buy Mi-4

New Delhi—Indian government has decided to buy a "number" of Soviet Mi-4 helicopters for operations on India's northern frontier. Government previously had purchased two Sikorsky S-62s and, it is understood, so far has bought one Mi-4.

Sources said decision to buy the Mi-4 basically was price—$150,000 for the Soviet aircraft, against $260,000 for the S-62. In addition, Russians will accept payment in export commodities. During Mi-4 trials, government officials said, the helicopter carried a half-ton payload to a height of 20,800 ft.

Availability

• **First stage burns out** and separates about one-fifth of the way along the trajectory path.
• **Coast period** probably follows first-stage burnout in order to attain maximum range.
• **Second stage is ignited** and burnout brings the missile to about the half-way point in the trajectory.
• **After separation** of second stage, warhead continues along the ascending trajectory, reaching a peak altitude of perhaps 250 naut. mi. as it begins its descent to impact on the target approximately 1,000 naut. mi. from launch point.

Ability to introduce azimuth corrections at the inception of the missile's pitch-up phase indicates that more than one of the missiles could be launched simultaneously or in fast succession, with some being programed for off-course trajectories to give an almost instantaneous impacting capability over a substantial lateral spread. However, this off-course trajectory capability is achieved at the expense of range. A 45-deg. azimuth turn at pitch-up might cut range to about 875 naut. mi., and the range would decrease rapidly with increasing angles of launch to the side.

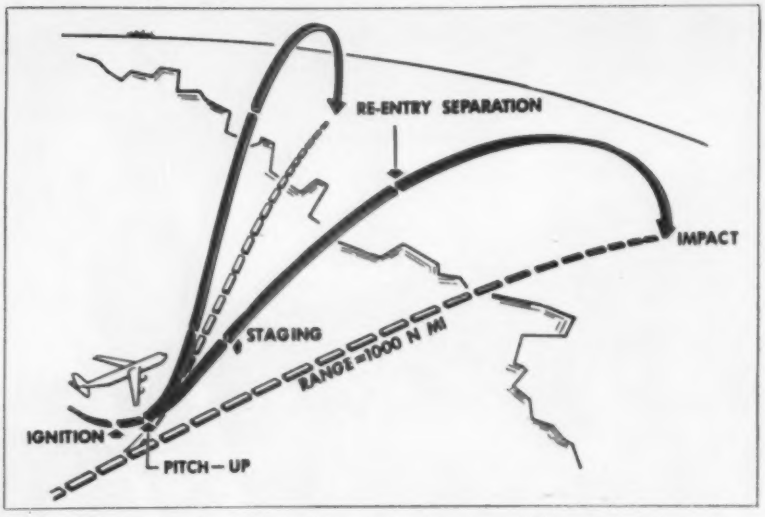
Development Program

Basic guidelines laid down for the Skybolt development program stress the following factors:
• **Schedule realism** and control.
• **Cost realism** and control.
• **Minimum-risk** production design.
• **Major emphasis** on reliability and maintenance.
• **Concurrent ground support** equipment development.
• **Early training.**

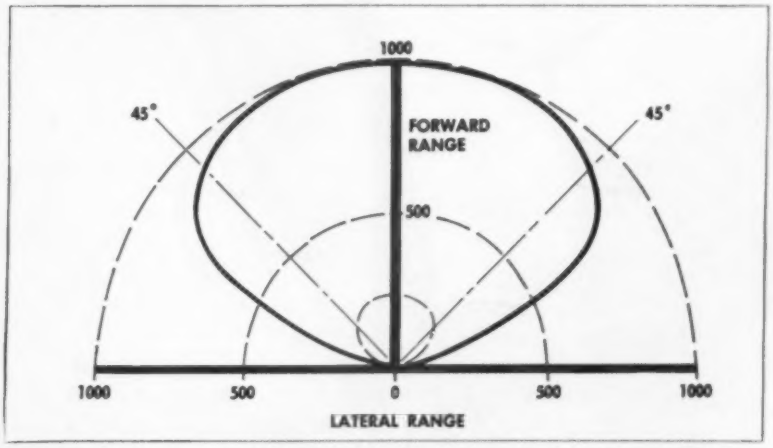
Reports indicate that research and development costs for the weapon system may rise from an original estimate of approximately $138 million to close to $380 million. Contributing factors are reported to include engineering changes introduced by Wright Air Development Division's Weapon System Project Office, the cognizant military agency, and the aspects of minimum risk design and major emphasis on reliability. Still another contributing factor is reported to be the huge volume of program evaluation procedures (PEP) reports which are required to be submitted periodically to WADD under the program. These reports consume considerable man-hours for preparation, tending to spread engineering talent thin. Some observers question the value of the informational return compared with the magnitude of engineering input.

Highlights of the Skybolt weapon

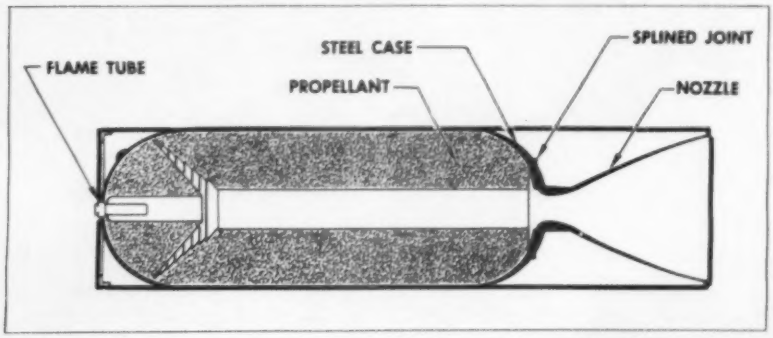
AVIATION WEEK ARTIST'S CONCEPTION of Skybolt air-launched ballistic missile shows how configuration probably has changed as a result of elimination of canard control surfaces from second stage. Missile is viewed from above shortly after it has been dropped from B-52, ignited, then programed into pitch-up phase for out-of-atmosphere trajectory.



TRAJECTORY pattern for Skybolt after gravity drop from B-52 reveals main sequence of events ending in impact on target 1,000 naut. mi. away. Missile also may be programed during pitch-up into azimuth heading away from a trajectory directly ahead of the aircraft, but this maneuver results in lesser range.



FLEXIBILITY of weapon for blanketing a broad lateral target area is shown in this plot of off-course range capability. Missile may be programed at beginning of pitch-up phase to either side of the forward 1,000-naut. mi. straight range path, attaining lesser ranges as the side angle is increased. Fall-off becomes sharp after 45 deg. off-course heading.



SKYBOLT'S first-stage rocket motor could approximate 12½ ft. in length if diameter is about 3 ft. Splined joint between steel case and nozzle indicates that nozzle is fixed, hence control of missile during booster operation would be by movable fins on missile base. Nozzle section of Skybolt's first-stage motor approximates one-quarter the stage's over-all length. Several successful firings of the rocket motor already have been made.

system program include these milestones:

- **System configuration** (already accomplished).
- **Missile mockup** (accomplished).
- **Engine tests** (accomplished).
- **Dummy drop tests.** (This and all following tests are scheduled for the near future, extending to operational squadron trials in 1964.)
- **Guidance sled tests** (Edwards AFB).
- **Programed flight tests.**
- **Captive flight tests.**
- **Guided flight tests.**

Test Sites

All aircraft/missile tests probably will be conducted from Eglin AFB, Fla., as the staging site, with actual runs made over the Atlantic Missile Range, out of Patrick AFB. The dummy drop, programed flight, and guided flight tests probably will be monitored by AMR tracking installations on Grand Bahama, Watling Island (San Salvador), and Grand Turk, depending upon the range programed for the missiles in the tests. A full-scale, 1,000-naut. mi. range firing would impact the missile into the Atlantic Ocean substantially before it could reach the area of the tracking station at Antigua.

Avro Vulcan bombers will be flown to the United States to participate in the development and test program (AW Sept. 19, p. 39).

For ground checkout of the missile system, a comparatively standard checkout set—the AN/GJQ-9—for which Bendix is the prime contractor, will be used in conjunction with 10 adapters to monitor specific weapon subsystem circuits.

Speculation on B-70

Considerable speculation has arisen as to whether the Skybolt might ultimately be adapted for the North American B-70 Mach 3 intercontinental bomber if development of this aircraft is pushed to operational status. It is almost certain that the Skybolt in its present configuration, as designed for deployment with the B-52 and the Vulcan, would not fit the B-70 role. Launch from the 70,000 to 80,000-ft. altitude of the B-70, coupled with the plane's Mach 3 speed, would alter substantially the flight characteristics of the Skybolt, which has been tailored to a projected operational launch condition of approximately Mach 0.75 to 0.8 at about 35,000 to 40,000 ft.

If Douglas has authority from the Air Force for product improvement of the Skybolt, it is likely that it is studying a version of the air-launched ballistic missile which might fit the B-70's operational requirement. But this missile would constitute a modification sufficiently different to be considered a second-generation Skybolt.

Inter-Union Fight Looms at ICBM Sites

By Russell Hawkes

Los Angeles—Industry officials are watching for a big step-up in the tempo of labor union jurisdictional fighting over missile base installation jobs as the possible consequence of a National Labor Relations Board hearing this week at Cheyenne, Wyo.

The hearing is on a petition of the International Brotherhood of Electrical Workers to certify an IBEW bargaining unit among Convair-Astronautics employes installing Atlas missile systems at nearby Warren AFB. The petition covers fewer than 50 workers, but industry officials and union leaders queried by AVIATION WEEK said the terms of the board's decision may touch off labor strife on a scale not yet seen in the ballistic missile program.

They say the crux of the problem is a concerted invasion of technical jobs in the installation and checkout of ballistic missile systems by construction contractors and their building trades unions. Regardless of whether conflict can be avoided in the Cheyenne decision, the stiffening resistance of missile system prime contractors and their industrial unions appears to be heading the ballistic missile base development program toward labor crises more formidable than those which have already cost an estimated 30,000 man-days of work in strikes that tied up the program for a total of almost 15 weeks.

The danger in the Cheyenne hearings stems from the fact that the International Assn. of Machinists, an industrial union, has already been certified to represent Convair employes at Warren. If the new IBEW petition is granted in terms that appear to cancel provisions of the IAM contract with Convair, IAM officials promise a strong reaction and United Auto Workers officials say they will support IAM.

United Auto Workers Vice President Leonard Woodcock told AVIATION WEEK, "We regard this as an important dispute and believe we have a strong future interest in the outcome, though IAM now represents most of the industrial workers employed at the missile sites. If the Cheyenne decision shows that a bureau of the Department of Labor can void a certification, we would favor a major strike to obtain better protection. I think reason will prevail before an industry-wide strike becomes necessary."

The IBEW petition was presented once before and rejected by the NLRB regional director, following a precedent set in an earlier decision of the board. The decision of the regional director was reversed by the board despite the precedent cited and a hearing officer was appointed to reconsider the case. International Assn. of Machinists Vice President Roy Brown said "in view of the fact that NLRB has reversed its own regional director, we think there is more than casual significance in this case."

Caught in a squeeze between public pressure to accelerate the program and the demonstrated ability of unions to halt it, USAF and industry have generally acceded to the demands of the aggressive buildings trades unions in the past. Industrial unions, mainly the IAM and the UAW, now have recognized that the base program will eventually employ well over 100,000 persons and are now mobilizing to save those jobs for their own members.

All the indications show that USAF is headed into another squeeze—this time between the industrial unions and the building trades unions.

The weapon which the building trades unions has used to take over jobs on the missile bases is the Davis-Bacon Act of 1931, a depression measure to support wages paid to building and construction men working on government buildings and public works. The law says only that prevailing local building trades wages must be paid on such projects.

Davis-Bacon rates are typically between $4 and $5 an hour—far higher than industrial labor wages but lacking the fringe benefits and comparatively steady employment won by the industrial unions. Missile manufacturers who must pay these extra benefits cannot at the same time meet the Davis-Bacon scale of basic wages. Building trades unions have been taking over jobs by defining them as "construction work" and pointing out the higher wage differential.

The practice of carving out bargaining units among the employes of the prime contractor, as IBEW is now trying to do at Cheyenne, has been rare. It has been more common for the primes to subcontract disputed jobs to local building companies.

The industrial union position was stated by A. C. McGraw, IAM headquarters representative in the Southwest. He said, "The Davis-Bacon law must be changed and we are going to raise so much hell in the next few years they [Congress] will be glad to change it." McGraw told AVIATION WEEK, "A union that controls work on the ballistic missile sites will control half of U.S. industry if it is not squeamish about how it uses its power." He bases his belief on the size and value of the installations and on the large number of industries that contribute to the end product.

Though they cannot afford to be quoted, officials of most of the missile primes are in accord with their industrial unions on the question of opposing the building contractors and building trades unions. They have found it difficult to control the quality and pace

Advent Solar Cells Detailed

Santa Monica, Calif.—More than 30,000 solar cells which will be mounted on two panels of the Project Advent real-time communications satellite are to be covered with fused quartz to protect them from integrated radiation dosages anticipated at the projected 20,000 naut. mi. orbit, a General Electric Co. engineer reported here last week.

Speaking before the American Rocket Society Space Power Systems Conference, Richard W. Karcher, of the Missile and Space Vehicles Department, said the 70-mil-thick quartz covering is 11 times thicker than the protective covering employed in any previous U.S. satellite. The mass of this shielding, and not mechanical requirements of the vehicle, will impose upper limits on the vehicle's structure, Karcher indicated. Missile and Space Vehicle Department has responsibility for the final stage Advent vehicle and its powerplant; the airborne communications are to be provided by Bendix Corp. (AW Aug. 29, p. 30). The vehicle is expected to have a three-year life.

In one projected configuration, solar cells will cover one side of each of two panels, which will rotate with respect to the vehicle, to be promptly oriented with the sun. Both front and back sides of the panels will be shielded. The vehicle will be flipped once in each orbit to re-orient panels for the next orbit, thereby eliminating the need for sliprings.

To obtain the 28-v. output required for operation of electronic gear, 70 silicon solar cell shingles will be electrically connected in series. Columns of these cells will then be paralleled, much like a ladder. To then minimize power loss in the event of a cell failure, the design called for paralleling each silicon shingle with its corresponding cell in an adjacent column. A minimum of three columns will be connected and grouped in this fashion, Karcher said.

of work subcontracted to local building trades contractors. They would prefer to send installation and checkout teams from their factories. Under weapon system contracting practices the primes are responsible for the work of their subcontractors and are quick to feel Air Force displeasure. Primes are also sensitive to the fact that excessive subcontracting dilutes their own profits.

Lacking a legislative change in the Davis-Bacon Act, IAM, USAF and industry would prefer a legal test and a favorable decision in the U. S. Supreme Court. This would be less satisfactory but easier to obtain. The Cheyenne decision may provide the opportunity for such a test. Legislative remedies suggested by some labor experts include repeal of Davis-Bacon, provisions that the contracting government agencies determine Davis-Bacon coverage, and acceptance of collectively bargained pay rates as full compliance with the law.

Job Descriptions

The collectively bargained contracts between missile manufacturers and their industrial unions include a detailed description of the jobs covered and how the contracts are enforced under terms of the National Labor Relations Act of 1935. Under present interpretations of the Davis-Bacon Act, the two laws can be made to oppose each other. Neither law recognizes the validity of the other or makes any exception for it.

Conflict between the laws could be postponed for as long as primes were willing to subcontract jobs which the construction trades unions wanted. In labor contracts between the missile builders and industrial unions, the right to subcontract is reserved to the company. If the missile prime refuses to subcontract and NLRB does not certify a building trades bargaining unit among the contractor's employes, then the building trades unions can be expected to strike.

IAM's McGraw told AVIATION WEEK that if the primes stand fast against pressure to subcontract outside the aerospace industry, IAM will man every job the building trade unions strike.

At Air Force request, the Department of Labor has prepared a memorandum draft of criteria by which to determine what is Davis-Bacon work and what is not. The draft has been sent to interested parties for their comments and a revised draft is now being prepared. The list of criteria is considered hot and industry and labor officials predict it will not be signed before the national election.

Reactions to the draft were highly varied. The Aerospace Industries Assn. commentary said the tentative draft "would aggravate rather than eliminate the difficulties unless the draft is revised in significant respects." Some industry officials called it "an abject surrender" to the building trades interests. Industrial union officials were less alarmed. One said, "the abject surrender was made long ago. The list of criteria merely acknowledges it." There was even some cautious optimism among labor leaders that the criteria might be subject to interpretation which could well be favorable with the full political weight of the industrial unions brought to bear on the subject. They quote a saying that "a bad agreement with good enforcement is worth more than a good agreement with bad enforcement." One called industry leaders "foolish for expecting anything better after 10 years of appeasement of the building trades."

Second Draft

The second draft of the Davis-Bacon criteria is reported to include some recommendations from the Aerospace Industries Assn. Brown disparaged any improvements that might be made in the criteria. He said that the best that can be expected of the criteria is that they could be made to be "salve on the sore."

McGraw said that he believes companies in the industry are beginning to realize they will gain by using union political influence to get political relief. He speculated that union support on this issue might well earn IAM some concessions from companies and from USAF.

Both union leaders and company officials expressed the belief that construction companies and their unions were cooperating on strikes and other measures aimed at driving missile base installation work out of the hands of the prime contractors. The Associated General Contractors, official spokesman of the construction industry, has been called the most powerful single organization of employers in the country.

Some Blame Accepted

Military, industry and industrial labor leaders all accepted some blame for the present situation but tended to shift most of the responsibility to others. Some Air Force and industry officials believe Army Corps of Engineers Brig. Gen. Alvin C. Welling was appointed to head the Corps' Ballistic Missile Construction Office with specific instructions to straighten out the entire labor problem on the new bases. Gen. Welling was quick to deny this when he was interviewed by AVIATION WEEK. He pointed out that the Corps of Engineers is responsible only for the "bricks and mortar" and the basic utilities: heat, air conditioning, water and electrical power. Welling says his only concern is that a strike against an Air Force contractor might also halt his own work.

In all its jobs, the Corps of Engineers deals with the building trades and has developed a method of operation that seems to work. Most of the authority in building trade unions is at the local level which makes them fast in a dispute with management. They can stop work on a project within a few hours of discovering a grievance. To cope with this speedy reaction, the Corps of Engineers has learned to keep a full-time labor relations expert at every site. USAF is planning to copy this practice. Companies with missile contracts are learning to keep an executive airplane available for their industrial relations departments at all hours of the day.

Labor relations experts say many of the jurisdictional disputes could be avoided by doing away with "joint occupancy" of the site by Corps of Engineers contractors and Air Force contractors. Joint occupancy is supposed to speed the program by allowing Corps work and Air Force work to proceed at the same time. However, building trades workers under Corps contracts have taken the opportunity to scout around for Air Force jobs to take over. Since some of the jobs require only a few days of work, the trade unions sometimes strike immediately to prevent progress during discussion of their demands.

Industrial union officials claim to be more responsive to the needs and aims of employers and their customers than the trade and craft unions because they

Space Batteries

Santa Monica, Calif.—In an effort to obtain better quality nickel cadmium storage batteries for use in missiles and space vehicles, the Department of Defense—through Advanced Research Projects Agency—will initiate a research and development program in batteries for space purposes.

First step will be to bring together missile and space technology companies and battery manufacturers for a symposium at U. S. Army Signal Research and Development Laboratory on Oct. 18-19 to discuss size and configuration, assembly and testing techniques of the desired storage batteries.

Organizations expected to attend the symposium include Sonotone, Gulton Industries, Eagle-Picher, Edison Laboratories, Bell Telephone Laboratories, Radio Corp. of America, Philco, Johns Hopkins University, Boeing Airplane, Lockheed, Hoffman, Jet Propulsion Laboratory, General Electric, Chance-Vought, Space Technology Laboratories, Gould National Battery, Inc., and Electric Storage Battery Co.

are working for long-haul gains rather than for immediate advantages on the job in hand. They say building trades workers tend to be migratory and a job lasting days or weeks covers their known future.

Air Force Ballistic Missile Center is officially uncommitted to either side in the struggle for missile site jobs. Air Force is prohibited by law from exercising any direct influence upon the problem. However, the indirect influence of the military is considerable because of its power to let contracts. The labor relations history of a company is regarded as a proper factor to consider in deciding who will be awarded a contract.

At present, BMC officers support the position of the missile system contractors and the industrial unions, at least tacitly. They say the people most familiar with the system should do the work regardless of their union connections. In some cases this would include trade and craft unions. The general philosophy of BMC as stated publicly by its commander, Maj. Gen. Thomas P. Gerrity, coincides with industry theory as to why installation and checkout contracts should not be let to anyone outside the industry.

Both regard the work as "production" rather than "construction." Gen. Gerrity refers to "construction, installation, checkout and delivery of operational missile systems at the sites" as an "extension of the factory into the field." Obviously, this can be made into an argument that the Davis-Bacon Act is not applicable, since the law applies specifically to construction work. There is a trend toward more prefabrication work in the factory to cut down the area of dispute at the site.

Despite the similarity of these statements, the final position of BMC in the dispute is still uncertain. Headquarters USAF has sent a labor consultant to the command who says that the Air Force is not sufficiently "craft union oriented." Gen. Gerrity and his staff are displeased with all parties to the dispute. While they believe that "product-oriented people work harder on the projects," inspection parties at the missile sites have observed that only half the people drawing pay were working, regardless of their affiliations.

McGraw, of IAM, told AVIATION WEEK that the impending disputes may become serious enough to serve as an excuse for splitting apart the American Federation of Labor and Congress of Industrial Organizations again. The AFL is composed mainly of trade and craft unions and the CIO of industrial unions. McGraw emphasized that the missile base issue would be the excuse, not the cause.

He said there are deep cleavages between the two bodies that make their present unification tenuous.

Strong Research Center Is Urged To Handle Weather Satellite Data

Washington—Weather satellites soon may be producing as much information in one day as the total present accumulation of all meteorological data, creating an "extraordinarily complex" data-handling problem that makes organization of a strong national research center imperative, a National Academy of Sciences committee said last week.

Plans to establish a National Center for Atmospheric Research on a relatively small scale were announced last summer by the National Science Foundation—a government agency—largely because of the efforts of the non-governmental academy (AW July 4, p. 28). The center was considered at the time to be a compromise with stronger academy recommendations for a larger atmospherics institute.

Last week's report, by the academy's Committee on Atmospheric Science, is partly an attempt to increase the tempo of government, university and private efforts to meet the rapidly increasing need for research, coordination and utilization of atmospheric information.

"There exists at the moment no organization or group in the world that is prepared to exploit fully the new wealth of information that meteorological satellites will certainly provide," the committee said.

"Thus, the huge expenditure of scientific effort, engineering and finances in meteorological satellites may be largely wasted unless a proper organization is ready to exploit the informational output of the meteorological satellites for the increase of our knowledge and the construction of a sound, theoretical foundation upon which a new order of practical forecasting can be based."

Focal Point

The academy accepts the research center as the proper focal point for such an undertaking, but feels that the government-led effort must proceed much more rapidly.

As an example of the problem, one committee member told AVIATION WEEK that the U. S. Weather Bureau already has a problem in handling and applying the meteorological information from the 23,000 photographs taken by the Tiros I satellite. Tiros II will carry both cameras and radiation sensors, and will produce approximately twice the amount of information that the first Tiros did.

In related developments, National Aeronautics and Space Administration and the Weather Bureau have invited 21 nations to participate in meteorological research connected with Tiros II, and the Bureau has announced that the first phase of an improved global weather communications network began operation on Oct. 1.

NASA intends to provide orbital information, radiation experiment data and cloud cover photos to other nations, which can then correlate this information with their own observations made from below the clouds, from sounding rockets, etc. The countries include the Soviet Union, Poland and Czechoslovakia.

The global communications network, organized through the World Meteorological Organization of the United Nations, will consist of an unbroken chain of point-to-point radio teletypewriter and land-line teletypewriter circuits circling the northern and southern hemispheres. The portion now in operation links New York, Frankfurt/Offenbach, Moscow and New Delhi. Next spring, Tokyo will be added. Later a southern hemisphere network will be formed and linked to the northern net.

Exchanges Recommended

The academy committee's report, titled "Meteorology on the Move," recommended a year-long series of meetings sponsored by university, research and scientific agencies to exchange information on experimental techniques.

The committee also endorsed five recommendations made last April by an advisory committee of the Commerce Department, which is the Weather Bureau's parent agency. The recommendations included the following:

- **Four-to-ten-fold expansion** of Weather Bureau's research over the next five years, with emphasis on experimental research and instrument development, and with growth rate geared to the growth of the atmospheric research center.
- **Naming of an assistant secretary** of commerce for science and technology who would be responsible for research in the National Bureau of Standards, Patent Office, Coast and Geodetic Survey, Weather Bureau and Office of Technical Services, which distributes abstracts on U. S. research and a number of translations of Soviet research literature.

The academy committee was headed by Dr. Paul E. Klopsteg. He has since retired, and Dr. Michael Ference, Jr., of the Ford Motor Co. Scientific Laboratory, is now chairman. Membership included Dr. Hugh L. Dryden, deputy administrator of NASA.

NASA Re-Emphasizes Role of Contractors

By Edward H. Kolcum

Huntsville, Ala.—National Aeronautics and Space Administration emphasized last week that it plans to rely heavily on industry participation in Saturn and other programs at its Marshall Space Flight Center, attempting to calm contractor fears that the agency would do most of the work at its facilities here.

Marshall officials told nearly 400 contractor representatives at the third in a series of four NASA-industry conferences (AW Sept. 5, p. 26) that the center will offer industry a substantial role in its projects. Major prize will be the multi-million dollar air-frame production and vehicle assembly contract for the Saturn booster which NASA is certain to award if the test program is successful.

The conference was used to counter industry complaints that NASA will push in-house development and fabrication of its carrier vehicle programs at Marshall, rather than opening the programs to contract. These industry fears stem from the tendency of the Marshall group to keep most work in-house when it was an Army missile group before transferring to NASA.

Dr. Wernher von Braun, Marshall director, said his center retains less than 15% of the $350 million it receives, that this portion is necessary to establish standards and to keep sharp the judgments of those who manage programs.

Eleven other Marshall spokesmen restated this position, and they emphasized the theme that success in space programs depends upon an industrial base unafraid to gamble with company funds, and willing to join the national space development effort.

Emphasis on Saturn

Discussion of Marshall programs was highlighted by the emphasis in direct and supporting efforts Marshall is placing on the 1.5-million lb. thrust Saturn vehicle. Dr. Oswald H. Lange, Saturn Systems Office chief, said specifications for the C-2 second stage now are being drawn up, and industry will be invited to bid on the 200,000 lb. thrust engine following a conference next spring.

Dr. Lange said that booster assembly eventually will be contracted to industry, and contracts will be awarded for some of the structural components this year. Timing of award of a large prime assembly contract, Lange said, will depend upon two contingencies: progress of the development program and assignment of a firm mission schedule. Latter contingency, he said, implies a close synchronization of payload to specific boosters.

Marshall tentatively plans payloads for the last four vehicles in the 10-launch C-1 development program.

Contractors also heard new details of the Mercury-Redstone (MR) program, flight missions for 11 of 16 Agena vehicles, and trends of future Marshall projects.

Dr. Joachim P. Keuttner, Marshall manager for Mercury, said the eight Redstones in the Mercury program have been delivered. Some will contain television cameras to provide real-time information on booster separation. MR-1 and MR-2 were built at Redstone Arsenal here, he said, and MR-2 through MR-8 were built at Chrysler Corp. in Detroit.

First Redstone Ready

Mercury Redstones are improved Jupiter C vehicles, with adapters added to bring their height to 85 ft. compared with the standard 69-ft. Redstone. Keuttner said that the first MR is on the pad at Cape Canaveral ready for launch.

Television system to be incorporated in the Redstones has been used in three tactical Redstone missile launches at White Sands Missile Range (AW Aug. 8, p. 30). Marshall has developed an abort-sensing system for the Mercury-Redstone which will program escape rocket ignition from four locations, Keuttner said. Abort sensors are located at the attitude controls, turn rate indicator, voltage control and combustion chamber.

Dr. Hans Heuter, director of Agena and Centaur programs, said the Ranger lunar exploration project will use five Atlas Agena B launch vehicles, two for spacecraft tests and three for lunar landing missions. The Thor Agena B will boost four Nimbus weather satellites, the orbiting geophysical observatory, and the Canadian topside sounder.

Future programs managed by Marshall will be concerned more with cost trends than are present projects, according to Heinz H. Koelle, director of the future projects office. Study contracts this fiscal year will be valued at $3.1 million and will attempt to find answers to these basic problems, foreseen in future systems:

- **Modifications necessary** to increase the usefulness of the Saturn booster, increase its thrust to 2 or 3 million lb. and recover all stages.
- **Role of nuclear** propulsion in carrier vehicles.
- **Optimum configuration,** and application, of the F-1 engine.
- **Maneuvers for rendezvous,** refueling, vehicle assembly and vehicle launch from orbit, to result in a flight performance manual for orbital operations.
- **Manned lunar** landing techniques.

Marshall this year will commit about $6 million for other industrial supporting research, Gerhard Heller of the Research Projects Division said, and he added that the best way for companies to impress the center's program managers is by knowledge of a proposal, not by the number of Ph.D.s who will work on it.

Research Support Areas

Current areas of research support in the Saturn project are pressurization of cryogenic propellant tanks, sealing in high vacuum with dry lubricants, welding large tanks, studies of bending behavior of large vehicles and methods of automating telemetry checkout of equipment.

Heller, who asked for strong and immediate industry participation, not only in going programs but also in establishing future projects, identified areas of Marshall interest in advancing the state of the art. These are shock wave detachment, reduction and evaluation of doppler data more quickly, tracking systems from launch point into orbit or escape trajectory, heat and energy transfer in the space environment, and long term guidance and control.

Because vehicles will become larger and more complicated, facilities construction and equipment contracting will continue to be an area of high potential for contractors, according to David Newby, technical services chief.

First Saturn Flight

Huntsville—First flight of the Saturn SA-1 first stage booster now is scheduled for June or July next year. Vehicle is being assembled here at Marshall Space Flight Center, and it will take 5-6 weeks to barge it to its launch facility at Atlantic Missile Range. NASA is preparing a second assembly area here in the Fabrication Laboratory so two Saturn boosters can be assembled simultaneously.

Saturn to Test Apollo

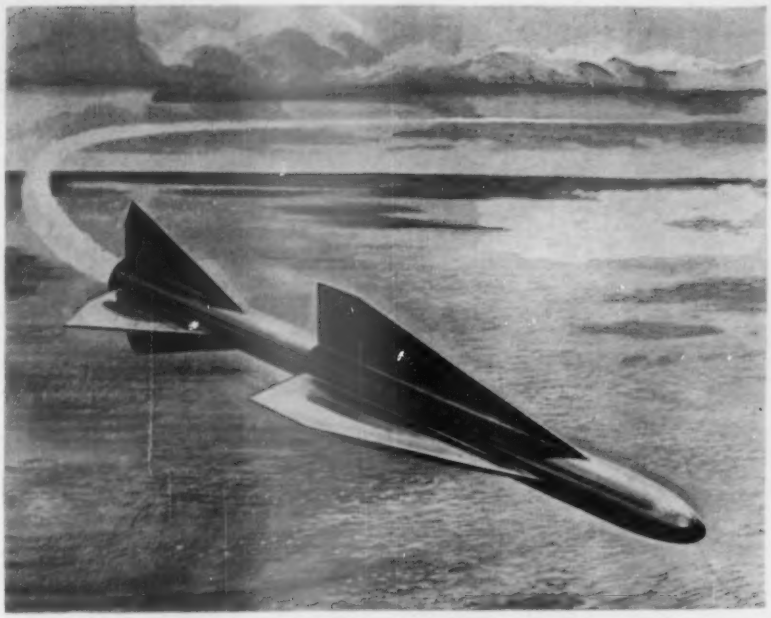
Huntsville—Saturn C-1, planned as the launch vehicle for unmanned soft lunar landings, has been assigned the added mission of qualifying the Project Apollo multi-man space capsule. Saturn Program Chief Dr. Oswald H. Lange said the C-1 will be able to carry a four-ton payload in a re-entry test and a 10-ton payload in orbital qualification flights.

NASA will spend $54 million for construction at Marshall and Cape Canaveral this fiscal year on approved facilities, and the center plans to request additional funds in coming budgets for these installations: liquid hydrogen test facility, instrument laboratory, structures test building, aeroballistics facility, photo laboratory and a maintenance building.

Lester Owen of the Launch Operations Directorate told contractors that NASA's immediate requirements at Pacific Missile Range are an engineering building, a telemetry and tracking station, and a central storage and issue room.

Contractors were urged by Harry H. Gorman, assistant deputy director, and Wilbur Davis, procurements and contracts chief, to participate in Marshall's work by making known their desire to do business, and by making certain Marshall knows their capabilities and experience.

Davis promised consideration of all proposals, and said Marshall has a policy of full and free competition in contract awards.



First Drawing Shows Eagle Configuration

Bendix Eagle air-to-air missile configuration is shown in Grumman artist's conception. Bendix is prime contractor for the Navy weapon; Grumman is responsible for the airframe and ground handling equipment (AW Sept. 19, p. 121).

France Compromises On NATO Integration

Paris—After months of negotiation a compromise agreement has been worked out by North Atlantic Treaty Organization military officials under which France agrees to integrate a large proportion of its air force within the common NATO air defense system.

The NATO Permanent Council, meeting at midweek in Paris, approved the deal which reportedly was worked out between Gen. Lauris Norstad, supreme allied commander, Allied Forces, Europe, and Gen. Paul Ely, French chief of staff. The agreement was described by a NATO spokesman as "not perfect, but a good working arrangement."

Under the agreement, France's air and radar units stationed in West Germany or along the German border in France will come under Gen. Norstad's direct command. French air force units elsewhere in France will remain under national control. Also, the agreement reportedly includes a clause—not confirmed by NATO's announcement—that French forces can be ordered to open fire only by a French officer.

This clause may merely be academic as the head of Allied Air Forces, central Europe, is French Gen. Maurice Challe.

It is expected the compromise arrangement will also apply to French anti-aircraft missile units currently being deployed in West Germany. The French are getting both Nike Ajax and Nike Hercules missiles from the U. S. under the military aid program.

The main French air contribution to NATO is the IER CATAC headquartered at Lahr, West Germany. Commanded by French Gen. Raymond Brohon, IER CATAC controls some 450 aircraft stationed in West Germany and in border areas in France.

This group currently belongs to the Fourth Allied Tactical Air Force which groups the U.S.'s main NATO air contribution, West German and French units. Gen. Brohon's IER CATAC apparently will now come under direct NATO control, instead of just cooperating with the North Atlantic Treaty Organization command.

Significantly, Gen. Brohon once told visiting reporters that no foreign officer, including Norstad, had the right to give him an order to deploy his forces and open fire on an enemy. The new compromise agreement seems to give Norstad the power to deploy French air units in the forward area. It may be, however, that the French have gained the second point—that French forces won't open fire unless the order is given by a French officer.

French IER CATAC uses mostly U.S. military aid aircraft—F-84Fs, RF-84Fs, F-86Ks and F-100s—as well as Dassault Mystere IVA fighters built in France under offshore orders. French-financed aircraft like the twin-jet Vautour bomber on the Super-Mystere have never been committed to NATO use. It is expected that France's latest fighter-interceptor—the Mirage III, just now coming off the production line—will also be kept out of NATO-committed units.

French sources warned that the air defense compromise doesn't mean France intends to give in on other disputes with NATO (AW Dec. 21, 1959, p. 24). These include the banning of nuclear-carrying U.S. fighter-bombers from France, the refusal to accept joint control of IRBM missiles with the U.S., and the refusal to integrate the French Mediterranean fleet under NATO command.

Admittedly, the French stand on central European air defense was its weakest case. Retiring French Gen. Valluy, former head of Allied Air Forces, Central Europe, openly criticized his government's position on the air defense question along with Gen. de Gaulle's desire to build up a nuclear strike force independent of NATO.

Project Wedge

Seattle—Boeing is seeking companies to work with it on Project Wedge, a company-financed study for a bomber-reconnaissance vehicle version of Dyna-Soar. Boeing hopes to form two separate teams, each with six to eight companies of diverse skills, which will compete for the best technological approach. Each company on the teams will finance its own work and must agree to provide at least a prescribed minimum effort. Team members will, however, be free to attempt to sell any new techniques or hardware coming out of the program to the government or other users.

Scientists Analyze Lunar Orbit Failure

By Michael Yaffee

Cape Canaveral, Fla.—Project scientists are analyzing telemetry data from an unsuccessful U.S. lunar orbiter shot to find the reason for the abnormal ignition and burning of the second-stage Able engine, the apparent cause of the mission's failure. They will make their failure analysis by Oct. 10.

A new attempt to orbit an identical payload is expected to take place before the end of the year, possibly next month. At a post-launch briefing, a National Aeronautics and Space Administration spokesman said that another Atlas booster, Able second stage and payload were already available though not yet at Cape Canaveral, and that a third-stage engine would be ready shortly. Moreover, NASA has a definite launch date assigned for the backup shot.

Preliminary analysis of the telemetry data shows probable abnormal ignition and definite abnormal burning of the second stage engine. Although the reasons for this are not known, some sources close to the project believe that failure of one of the explosive bolts between the first and second stages to blow may be a contributing cause. This could also explain the incorrect heading of the rocket that was indicated at the time of the failure.

The second-stage Aerojet-General engine, which had worked perfectly in 15 previous shots, checked out prior to launch along with the rest of the Atlas-Able V launch vehicle and Pioneer VI payload, according to Adolph K. Thiel, director of experimental space projects for Space Technology Laboratories which had the responsibility for system integration and spacecraft packaging. But when the second stage received the ignition signal, said Thiel, the engine apparently did not fire properly, nor did it appear to burn normally or long enough. (Normal burning time for the engine would have been 110 sec.)

The third-stage Hercules ABL solid propellant engine is not believed to have ignited. If it had, said Thiel, it probably would have gone in the wrong direction as a result of the malfunction in the second stage. The second and third stages along with the payload are believed to have come down somewhere in the Indian Ocean.

Launch Schedule

Originally, the lunar orbit launching was scheduled for the morning of Sept. 23. High winds and heavy rains from tropical storm Florence forced postponement of the shot to Sept. 25. The Atlas-Able V vehicle with its Pioneer spacecraft was launched at 10:13 a.m. EST. There was a 10-min. hold at T–7 min. that had been put into the schedule for timing purposes. There was a 2,500-ft. ceiling, 7-mi. visibility, and wind of 5 kt.

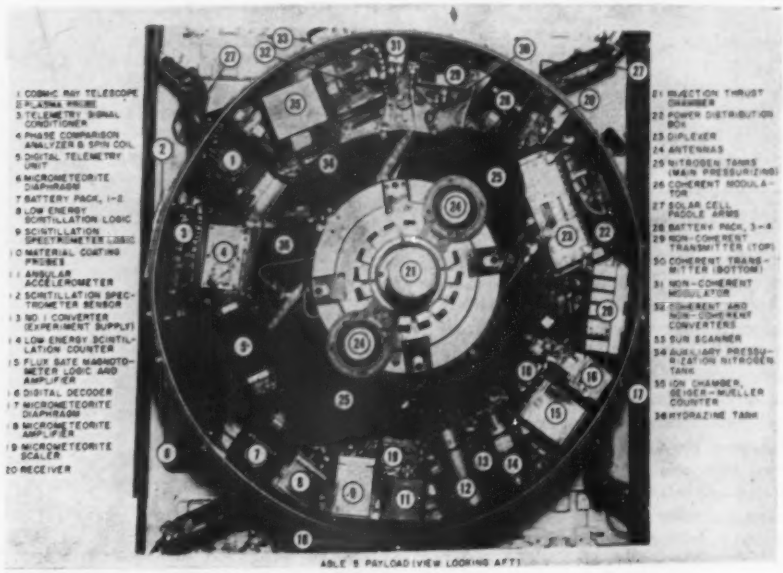
The launching was normal in every respect, according to Col. Paul P. Wignall, commander of Air Force Ballistic Missile Division's 6555th Test Wing (Development) which launched the vehicle. This was a NASA project carried out in cooperation with AFBMD which provided technical assistance.

The Atlas D first stage burned for 275 sec. after lift-off. While this is somewhat longer than in the regular Atlas missile mission, according to Col. Wignall, it is well within the D missile capability. The two Atlas booster engines were jettisoned after approximately 250 sec. At an altitude of approximately 200 naut. mi., after the sustainer engine had burned out and the Atlas had separated or was supposed to separate from the remaining stages, the second-stage Able engine ignited, trouble developed and the mission was aborted. Elementary signals were received from the payload for approximately 1,020 sec.

If the mission—whose cost was estimated at $9-$10 million—had succeeded as planned, the 387-lb. Pioneer VI spacecraft would have intersected the path of the moon about 62 hr. after lift-off from Cape Canaveral. At this point, retrothrust from the spacecraft's unusual hydrazine monopropellant rocket engine (AW Sept. 12, p. 56) would have been used to cut the sphere's speed about in half to approximately 3,000 mph. in order that the spacecraft might be caught and held by the moon's weak gravitational field instead of shooting on into deep space.

Except for the substitution of a scintillation spectrometer and a plasma probe for the comparatively heavy and bulky TV-like scanner, payload of the Pioneer VI paddlewheel lunar orbiter was essentially the same as that of Project Able IV (AW Dec. 7, p. 53), which failed shortly after lift-off on Nov. 26, 1959, when the plastic shroud covering the payload fell away. Purpose of both missions was to obtain basic data on the lunar environment.

The highly-sensitive scintillation spectrometer carried by Pioneer VI was designed not only to measure the cosmic particles (mostly protons) but also to separate them according to their energy levels. In addition the 39-in. aluminum alloy sphere carried a micrometeorite detector externally and, internally, a high-energy radiation counter, an ionization chamber and Geiger-Mueller tube to measure total radiation flux, a low-energy radiation counter, a flux-gate magnetometer and a spin-search coil magnetometer which would have been capable of detecting a lunar magnetic field as low as one gamma, a sun scanner to supplement other data by taking fixes on the sun, and a plasma probe or radiation sensor to provide data on energies and momentum distribution of proton streams with energies above a few kilovolts.


1 COSMIC RAY TELESCOPE
2 PLASMA PROBE
3 TELEMETRY SIGNAL CONDITIONER
4 PHASE COMPARISON ANALYZER & SPIN COIL
5 DIGITAL TELEMETRY UNIT
6 MICROMETEORITE DIAPHRAGM
7 BATTERY PACK, 1–2
8 LOW ENERGY SCINTILLATION LOGIC
9 SCINTILLATION SPECTROMETER LOGIC
10 MATERIAL COATING PROBES
11 ANGULAR ACCELEROMETER
12 SCINTILLATION SPECTROMETER SENSOR
13 NO. 1 CONVERTER (EXPERIMENT SUPPLY)
14 LOW ENERGY SCINTILLATION COUNTER
15 FLUX GATE MAGNETOMETER LOGIC AND AMPLIFIER
16 DIGITAL DECODER
17 MICROMETEORITE DIAPHRAGM
18 MICROMETEORITE AMPLIFIER
19 MICROMETEORITE SCALER
20 RECEIVER
21 INJECTION THRUST CHAMBER
22 POWER DISTRIBUTION BOX
23 DIPLEXER
24 ANTENNAS
25 NITROGEN TANKS (MAIN PRESSURIZING)
26 COHERENT MODULATOR
27 SOLAR CELL PADDLE ARMS
28 BATTERY PACK, 3–4
29 NON-COHERENT TRANSMITTER (TOP)
30 COHERENT TRANSMITTER (BOTTOM)
31 NON-COHERENT MODULATOR
32 COHERENT AND NON-COHERENT CONVERTERS
33 SUN SCANNER
34 AUXILIARY PRESSURIZATION NITROGEN TANK
35 ION CHAMBER, GEIGER-MUELLER COUNTER
36 HYDRAZINE TANK
ABLE V PAYLOAD (VIEW LOOKING AFT)

PIONEER VI instrumentation payload is detailed above.

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Shift to Stronger B-70 Program May Help Other Aircraft Projects

San Francisco—Newly-won top priority for the USAF North American B-70 program assures manned aircraft a substantial role in the U. S. weapon system development effort that will form a link with manned space systems projected for the future.

The B-70 has been rescued from the skeleton development program planned by the Administration in its cutback last December, but the precise level of the newly-accelerated effort still hinges on a Defense Department choice of new funding plans proposed by USAF. Congress has added $183 million to the $75 million budget originally allotted the program, and USAF will get most of this extra money as soon as a decision is made how it should be spent.

With the increased effort, Wright Air Development Division's B-70 System Project Office has a force of 200 at work, and the Dyna-Soar SPO has reached a similar force level.

Victory of B-70 adherents in Pentagon policy councils may have brightened chances for two other advanced manned aircraft types USAF commands want. One is an interceptor proposed by Air Defense Command which would fly at 2,000 mph. over a range of 1,000 mi. It would be an advanced version of the canceled F-108 interceptor concept.

Second Project

Second project is the attack aircraft Tactical Air Command wants with the capability of flying at subsonic and supersonic speeds at low level. It would have variable-sweep wings to give it this capability. This project is funded for $25-30 million in Fiscal 1961. TAC also is interested in an intermediate range, solid propellant missile (AW Sept. 26, p. 25).

Air Force considers the Dyna-Soar program "properly funded" at present and says it will continue at a normal pace. A potential group of 20-30 pilots has been selected to begin training for the Dyna-Soar flight program.

Efforts of the Air Force to explore military uses for space were outlined at the Air Force Assn. convention here by USAF Ballistic Missile Division chief Maj. Gen. O. J. Ritland. He said all but five of the 19 major programs assigned to BMD are "concerned with searching out the possible advantages suggested by space."

BMD is concerned with development of major current ICBM programs, but Gen. Ritland said studies are under way on possible follow-on missiles. These studies include "but are not limited to" a smaller, lighter, cheaper, less vulnerable ICBM—generally known as Midgetman—"an ICBM of improved cost effectiveness over our present missiles."

For defense against ICBMs, Gen. Ritland observed that "it would seem prudent that we consider ways and means of intercepting and destroying such weapons at a point early in their period of powered flight." One method he suggested is an "orbiting sentinel"—an interceptor satellite that could sense the heat produced by a ballistic missile launch and fire a rocket to destroy the ICBM while it was still rising in its powered launch phase.

Radiation Satellite Yields New Solar Data

Washington—Data from Naval Research Laboratory's Radiation I satellite obtained during an 18-min. solar flare that occurred Aug. 6, has provided important clues to the nature of these solar storms and their effects on the earth's atmosphere (AW June 20, p. 76).

The satellite, launched June 22 with Transit IIA, has given scientists the first opportunity to correlate earth-based measurements, such as the blackout of radio communications, with measurements of X-ray and ultraviolet emissions from the sun which do not penetrate the earth's atmosphere.

The Aug. 6 flare conveniently began just as the Radiation I satellite was coming within range of a Minitrack station at Blossom Point, Md. Within one minute after start of the visible solar flare, shortwave radio signals began to fade. Two minutes later, cosmic radio noise which normally penetrates the ionosphere began to fade, coincident with an increase in solar X-ray intensity reported by the satellite.

One minute later, the sun began to emit strong electromagnetic radiation (noise) at a frequency of 2,800 mc., which lasted for about two minutes during which time the solar X-ray level increased sharply and remained intense, even after the burst of radio noise had disappeared. During the satellite's next pass over the station two hours later, the sun had returned to complete calm with no abnormal X-ray emission. Throughout the sequence of events, the sun's ultraviolet radiation remained completely unaffected, NRL scientists report.

Based on data obtained from the satellite, and earlier rocket measurements, NRL scientists believe that X-ray emission is a major aspect of solar flares and that the sun releases at least as much energy at X-ray frequencies as in the visible light region, and far more than in radio noise.

Scientists speculate that both the X-rays and radio noise may be generated high in the solar atmosphere, perhaps 50,000 mi. above the sun's surface. The findings to date have raised the important question of whether the X-ray emission appears before the visible flare and back-radiates to the solar surface to produce the visible flare.

Present indications are that the Radiation I satellite should have an operating lifetime of at least one year before its solar cells deteriorate sufficiently to cause the satellite transmitter to lose its voice, NRL says.

Berlin Air Access

Berlin—Three Western commanders of Berlin demanded last week that the Soviet Union continue to exercise full responsibility for safety of Allied aircraft flying the three air corridors across East Germany into Berlin.

A letter signed by the three commanders and delivered to Col. Gen. Nikolai F. Zakharov, Soviet commander in Berlin, pointed out that the corridors were established in 1945 by the Allied Control Council for Germany and that the Allied Powers "do not recognize any restrictions on the use of these corridors by their aircraft."

The message followed two earlier Soviet letters complaining that the corridors were being used "illegally," a general tightening of tension between East and West Germany and Soviet threats to turn over its control functions to East Germans.

Polaris A2X Readied For First Firing

Cape Canaveral, Fla.—Navy is preparing to fire the first of the new 1,500-mi. Polaris A2X submarine-launched missiles and first development flight tests will be made here later this year. Missile will be 30 in. longer than the A1 series but diameters remain the same.

Competition for the A2 second stage engine is between Hercules Powder Co.'s glass fiber-reinforced motor and Aerojet-General's titanium-encased motor.

In firings here, Navy had planned to launch two Polaris IRBM's from the submerged USS Patrick Henry within 6 min. The second of these two missiles, designated A1X-E7 (for evaluation) and A1X-E8, had new Aerojet engines with the lighter weight steel casings designed for the operational,

1,200-mi. A1 series that is scheduled for combat-readiness patrol this year.

First missile was fired at 5:05 p.m. EST. It cleared the water, failed to ignite and fell back into the ocean, reportedly ripping a 15-ft. gash in the thin fairing which covers the tops of the launching tubes. After surfacing, the Patrick Henry resubmerged and fired the second Polaris about 8 p.m. The second missile ignited, went out of control and tumbled into the ocean. Then the second stage apparently ignited and the missile was destroyed.

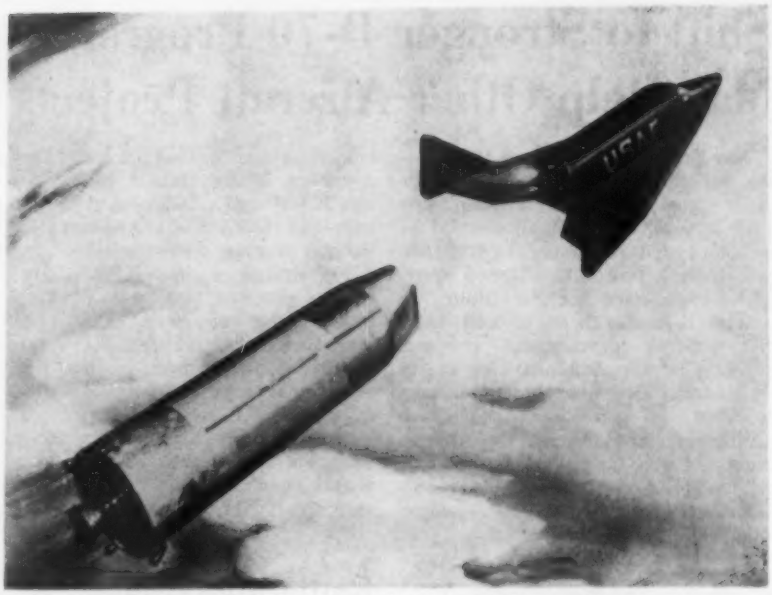
However, Navy successfully carried out a short-range flight test of the Mk. 3 operational nose cone, which was reported a complete success (AW Sept. 26, p. 29).

USAF Winter Study Conclusions Revealed

San Francisco—Some of the conclusions and recommendations made by Air Force's 140-man Winter Study Group on USAF's future needs in command and control systems were officially disclosed for the first time here by Maj. Gen. Kenneth P. Bergquist.

Gen. Bergquist, commander of AF's Command and Control Development Division, discussed the study at the Air Force Assn. convention and gave the following resume of conclusions contained in the nine-inch thick series of reports:

- **More attention** must be paid to planning during early conceptual phases of command and control systems to determine whether systems can be developed with existing state of the art and within available financial resources. "Particular emphasis must be placed upon a costing analysis of an unborn command and control system," Gen. Bergquist said.
- **More detailed guidance** to the system contractor must be provided by USAF on design emphasis and intersystem compatibility than in the past. This means USAF must acquire increased technical competence within its officer corps in the areas of electronics, data processing and computer programing so that military personnel can perform or at least supervise the latter two.
- **More attention** must be given to integration between different command and control systems so that such systems can rapidly communicate with one another. "Lack of compatibility could well [mean] . . . the eventual loss of control of the force," Gen. Bergquist warned.
- **Operating commands** need to recognize that efficient use of command and control systems may require changes in their previous procedures. "The real problem is how to control the force and not one of acquisition of mechanized equipment," Gen. Bergquist said.



First USAF Drawing of Dyna-Soar

USAF artist's concept of the Boeing Dyna-Soar boost glider separating from second stage of a modified Martin Titan confirms Aviation Week prediction on configuration (AW May 9, p. 26). Booster's first stage has two large and two small fins added for stability. Larger booster, probably Saturn, will be used for later orbital flights.

News Digest

Industrial team headed by Philco has won competition to construct new Defense National Communications Control Center in Washington for Defense Communications Agency. Other members of the team include Dunlap Associates, Hoffman Electronics Corp., and System Development Corp.

Army-Martin Pershing field ballistic missile has entered second phase of flight testing at Cape Canaveral, Fla.; both stages have been ignited for the first time. In two-stage firing, missile was programed for 160 mi. flight but malfunction developed after second stage ignition and the weapon was destroyed. Missile now has new nose cone, more sharply tapered than previous configuration (AW Mar. 14, p. 19).

Julian King Sprague, president and director of Sprague Electric Co., died of a heart attack Sept. 27. He was 57 years old.

Charles J. McCarthy will retire as board chairman of Chance Vought Aircraft Nov. 10. He has been with Vought since 1926, and has been chairman since 1954. No successor has yet been named.

Second World Congress of Flight will be held in Las Vegas, Nev., Sept. 13-21, 1962, in conjunction with the annual Air Force Assn. convention (AW Aug. 29, p. 25).

Martin Co. has awarded a multimillion dollar contract to Northrop Corp. for Air Force Titan ICBM base activation at Ellsworth AFB, Rapid City, S. D., covering installation and checkout of Titan missiles and ground equipment.

Sylvania Electric Co. has been awarded a $7.5 million subcontract by Boeing Airplane Co. to develop a jam-resistant radio launch control (earth current) communication system (AW May 18, 1959, p. 26) for Minuteman.

Contract to develop a restraint system to protect astronauts from capsule landing impact forces as high as 60g has been awarded to Chance Vought Astronautics Division by USAF. Division will develop the system for Aerospace Medical Division of Wright Air Development Division. Contract is for $120,000.

Nuclear-powered aircraft carrier Enterprise has been launched at the Newport News Shipbuilding and Drydock Co. for outfitting. It will be ready for service in about a year and a half.

Attempt to launch USAF-Martin Titan a record 10,000 mi. from Cape Canaveral, Fla., last week was only partially successful because of premature shutdown of second stage engine. Dummy warhead traveled 6,000 mi.

Eastern Eyes Lucrative Mexico Market

Jet transports have started shift in travel patterns; drop in traffic growth at Miami is marked example.

By Glenn Garrison

New York—Eastern Air Lines is planning a drive to develop its New York-Mexico City route, increasingly interesting to Eastern as Miami's growth as a travel market slows down.

Recent renegotiation of the U. S.-Mexico bilateral and Eastern's cooperation agreement with Aeronaves de Mexico will make it easier for Eastern to push development of its Mexico City route.

With the shifting of traditional vacation travel patterns already evident since the time-cutting jet transports have come into service, Mexico could eventually tap a large part of the northeastern market captured in the past by Miami. From Eastern's point of view, Mexico provides a long-haul route relatively free of the multiple competition of the Florida market.

New Areas

Mexico, of course, is not the only area that jet travel is opening up to the vacationer in search of new climes to conquer. According to a major New York travel agent, the shift already is taking place to some extent and Miami is being bypassed for places with more exotic atmospheres.

The jet airplane is "scattering" the travel market to Florida, the agent told AVIATION WEEK. Jamaica and Mexico City are examples of increasingly popular spots. Hawaii is becoming much bigger in the eastern market, he said, and is expected to increase in importance over the next few years. He predicted an influx of travel from the east to other Pacific areas.

Florida, for many years an airline market growing much faster than the domestic average, has slowed down considerably in the past few years. At Miami, airline boardings for the first six months of this year rose only .6% over the same period of 1959. The Florida Development Commission estimates that the number of tourists entering the state by air during the first six months of 1960 dropped 13% from last year's total for the period. Total for the 1960 period was 758,638 tourists.

Jet Influx

Airline officials concerned with the Florida market admit a leveling off since 1957. And this came at a time when the big high-capacity jets were about to be thrown into the competition, demanding considerably larger increases in traffic to keep them profitably busy.

Development of pleasure travel between the U. S. and Mexico has been held back in the past by many factors, particularly political ones. The first U. S.-Mexico bilateral was signed in 1957 and limitations of service have heavily restricted operation of the routes.

Eastern presently is flying one New York-Mexico City nonstop round trip daily, a Douglas DC-7B in all first-class configuration. Aeronaves de Mexico, flying the route on a reciprocal basis, uses a mixed-configuration Bristol Britannia turboprop. Capacity restriction has prevented Eastern from exploiting the tourist-class potential. Also, Eastern was prevented from putting jets on the route until Aeronaves could offer similar service.

DC-8 Delivery

To speed the introduction of jets, Eastern recently signed an agreement with the Mexican carrier under which Eastern is turning over its delivery place for one Douglas DC-8. Aeronaves will take delivery of this aircraft, and it is expected that both airlines will introduce jet service simultaneously before the end of this year.

The agreement also provides for a mutual exchange of facilities and services. Eastern will train Aeronaves' flight and mechanical personnel at

National Shows Interest in Caravelle

New York—National Airlines currently is showing serious interest in the Mark VII Sud Caravelle powered by General Electric turbofan engines which would displace Lockheed Electra turboprops on such routes as Boston-Washington-Jacksonville-Tampa.

Equipment planning by the carrier still is up in the air because of uncertainty over renewal of the Pan American lease now under negotiation and the possible award of a Southern Transcontinental route.

If current prospects work out, National might well shift its two Douglas DC-8s in service plus a third scheduled for delivery to handle the Southern Transcontinental business and buy Caravelles for use in the medium range New York-to-Florida routes, with any aircraft available on lease from Pan American to add flexibility to scheduling problems.

National has commitments from two New York banks for loans of $7.5 million each if it wins the Southern Transcontinental route, which could be used for purchase of new aircraft. National indicates it has potential purchasers for Electras, but would not give further details.

Registration for a $10,288,000 issue of convertible debentures is being sought by National to raise funds for $5,565,000 for three Electras and one DC-8 for delivery prior to June 30, 1961, and to retire approximately $3 million in short term bank loans. The undelivered Electras will be modified before leaving the factory.

Originally National had planned to obtain these funds through retained earnings, but in its Fiscal 1960 report issued last week, National reported a net loss after tax credits of $3,965,099 and an operating loss of $6,211,495.

Gross revenues dropped from $70,863,750 the previous year to $68,642,866 in Fiscal 1960. National President George T. Baker blamed the Cuban situation for a $2 million decline in revenue alone. National's surplus account dropped from $16 million to $10 million with the deficit.

Most of the revenue decline was in passenger revenue, but costs were up generally across the board—with flying operations, direct maintenance and passenger service showing the most pronounced rises. Besides its other resources, National holds 400,000 shares of Pan American World Airways stock, which the Civil Aeronautics Board has given National two years to dispose of and which has a market value of approximately $8 million.

Eastern's Miami jet training center. Aeronaves will use Eastern's facilities in its new terminal at Idlewild, New York. No financial investment by Eastern is involved in the agreement, and each carrier will keep its sales, reservations and customer service functions separate.

According to Eastern's estimate, the arrangement with Aeronaves has moved the jet introduction timetable up by 12 months. Eastern foresees a substantially greater tourist class traffic volume on the route during the first year of jet operations than normally would be expected in developing such a market. Reasons are that Mexico primarily is a tourist market and, because of the tourist class limitation, so far there has not been a great deal of promotion in the northeast. With the availability of adequate tourist-class facilities and an adequate promotional push, volume is expected to climb.

Last year Eastern carried 25,400 passengers in both directions on the New York-Mexico City nonstop route. All, of course, were first class. Aeronaves carried 43,463 passengers, of which 35,071 were tourist class. Air France, which has operated a nonstop service over the route for a number of years, carried 12,485 tourist and 5,596 first class passengers during 1959.

The total of the three carriers for 1959 was 86,944 passengers, up from 79,372 in 1958. Aeronaves' 1959 load factor was 70%, Air France's was 83%, and Eastern's was 55%. First class load factors of Aeronaves and Air France were 60% and 76%, respectively.

For 1960, Eastern has estimated that 23,650 one-way first class passengers will be carried by Eastern and Aeronaves. With a minimum tourist-first class ratio of 3 to 1, the number of one-way tourist passengers for the year would have approximated 70,950 between the two carriers, in Eastern's estimate. The total 1960 one-way traffic for Eastern and Aeronaves would have been about 94,600 passengers.

Although a number of additional route applications have been filed for new U. S.-Mexico routes opened up by the new bilateral signed last August, the present U. S. operators are American, primarily from Chicago to Mexico City; Eastern; and Western, serving the Mexican capital from Los Angeles. In addition to Aeronaves, CMA operates to the U. S., flying Comet jet equipment to Chicago and between Mexico and the West Coast to parallel Western's service.

American carried 115,000 passengers last year in and out of Mexico City. The airline operates a daily nonstop DC-7 coach from Chicago to Mexico City, and two other passenger flights from Texas, both of which provide connections with multi-stop flights from northern points.

Eastern's hopes of tapping the big travel markets of the northeast to develop Mexico City as a sort of second Miami Beach of air transportation are closely linked to the jet transport. Flying time between New York and Mexico, now about 8 hr. nonstop, will be almost halved by the DC-8s.

Nobody, especially airlines serving the route, is ready to write off Florida as a travel attraction. In terms of a mass market, the volume of air travel to that state still provides impressive base figures. The question seems to be whether its growth has not slowed to the point where it cannot absorb the expansion needs sharpened by jets and heavy competition.

Some indication of the trend can be seen in the following comparison of domestic airline boardings from most cities in Florida served by the carriers:

	Miami	All Fla.
	(in thousands)	
1954	886	1,569
1955	1,061	1,837
1956	1,252	2,134
1957	1,430	2,434
1958	1,341	2,335
1959	1,575	2,755

While Miami boardings were up slightly for the first six months of this year, the picture varied at other Florida cities. St. Petersburg-Clearwater boardings, for example, were down 17%. Tallahassee was down 10%; West Palm Beach was down 1.5%. On the other hand, Tampa, an important business travel city, showed a 6% increase.

These boarding figures include business as well as pleasure travel and also intrastate movements. The Florida Development Commission's figures are concerned only with non-business travelers crossing the border into Florida and do not include in-transit passengers.

The Commission's figures show an increase of 2% in automobile travelers, 5% in rail travelers, 6% in bus travelers for the six-month period.

Airborne tourists entering the state in January totaled 142,577, down 18%, which a Commission spokesman said resulted from the bomb scare then prominent in the news. Air traffic climbed back up in February, with a 7% increase; dropped 27% in March; rose 7% in April; dropped 20% in May; dropped 30% in June. It was during

Czechs to Renew Il-18 Flights

Prague—Czechoslovak Airline officials say they expect to place their fleet of four Soviet Il-18 turboprop transports, grounded since August, back into service sometime early this month. All Il-18s were grounded following the crash of an Aeroflot aircraft during a flight from Cairo to Moscow (AW Aug. 29, p. 45).

Czech officials declined to pinpoint problems found during the crash investigation but mentioned the electrical installations of the Il-18 are being revised. One official indicated a trouble area might lie in the fire prevention system in the wing section.

Legal Troubles Ground Cubans in New York

New York—Cuban Prime Minister Fidel Castro found himself without a ride home from the United Nations last week as a result of the impounding of two Cubana Airlines Bristol Britannia turboprop transports and one Aerovias Q Douglas DC-4, which forced a temporary suspension of service into New York by Cubana.

Castro was rescued from his dilemma by the generosity of Soviet Premier Nikita Khrushchev, who let him borrow one of the Soviet-built Il-18 turboprop transports which have been grounded from regular passenger service but which are being used for transatlantic courier service. Khrushchev and his party chose to travel to the United Nations by ship.

A Tu-114 transport, a large turboprop aircraft which has never seen scheduled passenger service, also is being used in the courier operation.

First attachment resulted from a suit by Harris & Co., a Miami firm, for alleged unpaid advertising bills, but the single Britannia that was impounded was later freed when the writ was vacated by a U. S. District Court. Now Cubana has filed a $3 million counter-claim against Harris & Co.

Another Britannia and the Aerovias Q DC-4 were then impounded when a stockholder, Ovido Manalich—claiming to own 6,000 shares in Cubana—filed a stockholder suit against the airline, resulting in a court-appointed receiver with control over Cubana's New York operation.

Actually, the Britannia managed to leave New York after depositing Castro and to return to Havana to pick up the rest of the Cuban delegation. When the plane returned two days later, it was impounded and the airline suspended service. According to Cubana officials here, service was scheduled to be resumed late last week.

Both transports were released on the day following Castro's Il-18 flight to Havana when the New York Supreme Court granted diplomatic immunity to Cuban aircraft in New York.

the latter month that Eastern, biggest operator in the Florida market, was crippled by a walkout of pilots.

The Commission's figures for the whole year of 1959 showed a total of 1,549,339 tourists entering Florida by air, an increase of 14% over 1958. Automobile was up 80% to 9,068,184, train up 3% to 386,269, and bus up 3% to 302,098.

As a factor in the slowdown of Florida tourist growth, several airlines cite the increased competition of services to new places now increasingly accessible by jet. Europe and Hawaii jet trips have lured some of the business. Another problem for Miami has been the loss of Cuba as an attraction for many people who went to Florida and over to Havana as a single vacation trip.

Among the areas now more accessible to the northeast, and showing impressive growth as travel attractions, is Puerto Rico. San Juan is now about 4 hr. 45 min. away from New York by jet, compared with almost 7 hr. by piston plane. In Fiscal 1960, Pan American's total in and out of Puerto Rico was 555,779 passengers, up from 494,227 in Fiscal 1959; Eastern's total was 356,425, up from 274,098; Trans Caribbean's total was 110,146, up from 82,829. These figures are from the Puerto Rico Economic Development Administration and include in-transit passengers.

Individual figures of the four biggest traffic carriers to Miami give a further indication of the slower growth of Miami as a travel market. During the five months December, 1959, through April, 1960, which include the heavy winter season, Eastern carried 754,620 passengers in and out of Miami. This was an increase of 127,850 over the same period of 1958-59, but the comparison is affected by the strike during the latter season which cut Eastern's operation over a period of several peak-season weeks.

Delta carried 204,432 passengers in and out of Miami during the same 1959-60 period, up from 159,872 passengers; National carried 348,211 passengers, down from 408,871, and Northeast carried 90,419 passengers, up from 80,885.

It should be noted that the 1958-59 base of the above comparison represents a poor season for the Florida carriers, so any improvement in 1959-60 would only be in the direction of climbing back to previous levels of growth.

For all of last year, Eastern carried 1,677,338 passengers in and out of Miami, up from 1,497,155 in 1958. Delta carried 296,364, up slightly from 291,169; National carried 739,385 passengers, up from 706,897; and Northeast carried 176,079, up from 174,760.

International Labor Group Probes Airline Employment Practices

By Cecil Brownlow

Geneva—Ad hoc committee of International Labor Organization composed of employer, employe and government representatives of 18 nations began probing international airline employment practices here last week after a reminder from the International Civil Aviation Organization that it remains the primary arbiter in this field.

The tripartite committee, successor to a 1956 bipartite conference in which employes and employers took turns blocking one another's resolutions, was convened by the governing body of ILO to consider two specific problems:

- **Condition of employment** in civil aviation.
- **"Hours of duty and rest** periods of flight personnel."

First item on employment conditions and what should be done to improve them is being considered primarily in plenary sessions of the full committee. Initial meetings last week made it clear that any broad base of understanding that could lead to proposed international standards will be difficult to achieve. It is hoped, however, that the debates, charges, demands and refusals aired in the general sessions will help pave the way to eventual adoption of uniform employment and working standards among the international airlines.

Flight Hours

Employe delegations are more optimistic over chances of pushing through resolutions on the second item that would establish guide lines on the maximum number of flight hours per month for any one crew on an international carrier.

If any resolutions are adopted by a majority vote before the committee completes its sessions here on Oct. 7, they will be forwarded to the ILO governing body and its governor general.

The governor general, if he approves of the resolutions, can either pass them along to the governments of the 83 member nations as formal ILO convention moves and ask that they be ratified into law or else simply request that they be forwarded to interested employe and employer groups for future bargaining purposes.

ILO officials hope that inclusion of government representatives will prevent any recurrence of the 1956 employe-employer deadlock, and that some definitive progress will be made. One U.S. delegate observed:

"The problem is that the employe groups get together and try to work out a common platform, and the employers do the same thing, but the government representatives all came here with briefs on what to do, so any common front would be hard to find."

Mild Statement

On the other hand, a number of observers were encouraged by the mildness of the ICAO representative's statement on the committee aims and relative reasonableness of statements by both employers and employes, particularly when compared with those of 1956.

J. A. Newton, chief of ICAO's Flight Branch, reminded the delegates that both ILO and ICAO are arms of the United Nations and that "it should be made clear" that his organization has the responsibility of regulating international operations dealing with air safety and efficient operations.

He noted:

"A number of subjects" to be discussed under the agenda item on employment conditions, are "basically ICAO matters," adding, however, that some have "social aspects" in which ILO has a legitimate interest.

Newton also was careful to point out that cooperation between ICAO and ILO has been "extremely successful" in the past and "no doubt will continue to be so." ILO officials took equal pains to stress the fact that ICAO had been consulted in drafting the agenda for the ad hoc committee meeting.

To avoid any possibility of an open

ILO Delegates

Geneva—U.S. delegates to the International Labor Organization's ad hoc committee on international airline employment practices here are:

- **Government—Claude R. Smith, chief of Federal Aviation Agency's International Organizations Division; George Tobias, special assistant to the assistant secretary of labor for international affairs.**
- **Employers—Everett M. Goulard, Pan American World Airways vice president for industrial relations; Joseph L. O'Brien, Air Transport Assn. vice president for personnel relations.**
- **Employes—Clarence Sayen, president of Air Line Pilots Assn.; Frank Heisler, airlines coordinator for the International Assn. of Machinists.**

clash with ICAO, ILO officials were expected to try to keep debate and resolutions limited to such "social" questions as job obsolescence, retirement age benefits, job security, number of hours jet transport crews can fly without impairment to health and similar matters.

However, vagueness as to just how deeply ILO can legitimately probe international airline employment practices without cutting across ICAO lines of authority probably will be used as a weapon by both employers and employes in rebuffing distasteful opposition proposals.

A representative of the employers' group, taking pains to note that ICAO and ILO "cooperate regularly," said last week that a number of major points "come under the cognizance of ICAO and the World Health Organization" and should be handled by them.

The employers' delegate also told the committee that the international airline employes are "in the forefront of social progress" among worker groups and warned that "it is impossible" for management officials to fulfill all requests made of them, some of which "are unreasonable to a liberal and open mind."

Earlier, United Kingdom employe representative D. S. Tennant, general secretary of the Merchant Navy and Airline Officers' Assn. and leading figure in the British Labor Party, termed "the social side" of airline employment "the missing link" and, in an obvious bid for support from some of the larger airlines, pointed out that "the operator who can operate with lower social costs" has a competitive advantage.

Tennant also demanded that pilots be told when their aircraft are carrying explosives or other dangerous materials and that airlines give greater attention to flight deck comfort aboard jet aircraft to prevent excessive fatigue.

D. Follows, a second British employe delegate and general secretary of the British Air Line Pilots Assn., and French delegate Andre Gely, member of the Federal Council of the French Federation of Commercial Aviation Navigators, followed with specific charges that aircrews often are subjected to defective lighting, radiation from radar installations, ultrasonic vibration, inadequate ventilation and faulty soundproofing.

Although a total of 18 nations were represented at the conference, there were only 16 official delegations, with Norway, Denmark and Sweden, joint operators of Scandinavian Airlines System, operating as a single unit.

A number of Iron Curtain countries, including the Soviet Union, are members of ILO, but none was invited to send representatives to the Geneva conference.

An ILO official explained this by saying that no Communist nation "is important as yet in international aviation, and that's what we're concerned with here."

Airlines Ask for Southern Routes; Merger Plans Denied by National

By Jerome Bailey

Washington—National Airlines stoutly denied any plans to merge with another carrier last week as it continued its fight for the new cross-country route which Civil Aeronautics Board Examiner Edward T. Stodola recommended in the Southern Transcontinental Service Case.

Denying merger rumors during oral argument in the route case National struck at an allegation made by American Airlines in a brief filed last August which charged that awarding the direct Southern Trancontinental Route to National would in effect be awarding it to some other carrier.

American stated in its brief that " . . . the point here . . . is that an extension of National in this case is virtually certain to be an extension for some other airline in the not too distant future."

National said it could see American would favor mergers because such action lessens the number of carriers left to compete with. National cautioned the CAB that ". . . perhaps the only way for the Board to force National to its knees and coerce it into merging with another carrier is to deny it this route," and that "to embark on a program of deliberately starving carriers into mergers in routes where they are geographically the logical carrier . . . will result in a highly centralized, non-competitive, unbalanced route structure."

American pointed out that the CAB's Bureau of Air Operations argued against approval of the Pan American World Airways-National stock exchange, maintaining that "it would mean that future extensions of National would in reality amount to future extensions of Pan American."

American urged the Board to extend its own routes eastward from Dallas/Ft. Worth to Florida via New Orleans.

Other carriers presented these cases during oral argument:

• **Trans World Airlines** told the Board it would offer as many as five daily turbojet round trip flights if it were awarded the authority to operate a route from Florida to California. TWA also cited New Orleans, Houston and Ft. Worth/Dallas as important markets in the Southern Transcontinental Route pattern.

• **Eastern Air Lines** charged monopoly in the examiner's recommended decision advocating substantial routes proposed for National Airlines and Delta Air Lines. Eastern's counsel commented that they ". . . by their sorry records in the interchange services, and over their monopoly segments in issue in this case, have guaranteed that they would ignore the public needs if authorized as proposed by the examiner." He urged the Board to give Eastern the major routes.

• **Continental Airlines** stressed the regional aspects of the case, saying "that Continental alone should serve the intermediate cities is firmly supported by the Board's long standing policy that the development of traffic and service in regional markets should be left primarily to regional carriers." The airline said Examiner Stodola's recommendation was "illogical" in that intermediate cities between Texas and California are placed on transcontinental routes.

• **Delta Air Lines,** recommended by the examiner for a second transcontinental route, expressed satisfaction with the examiner's recommendations as far as Delta is concerned, but opposed extension of Braniff Airways' routes from the Dallas/Ft. Worth area to Miami and the addition of National to the route from Houston to California. Delta's counsel asserted it would be uneconomical to make National another carrier to the West Coast. Delta also urged that the recommended restriction on New Orleans-to-the-west flights be removed in order that Delta be allowed to serve Los Angeles and San Francisco on one flight.

• **Western Air Lines** urged the Board to grant more long-haul services to it and Continental. The carrier said that unless the Board awards it "new long-haul jet routes in this case and in the Transpacific Case, it will be impossible for Western to maintain its present competitive position on its existing system" against larger carriers. Western said if it is overlooked in the Southern Transcontinental Case, the airline would lose about $2.2 million annually through diversion of traffic.

• **Braniff Airways** asked the Board to grant further authority to serve the West Coast from Houston and Dallas/Ft. Worth in addition to the recommended route from the two Texas areas to Florida. Braniff also asked the Board to remove recommended restrictions on the Florida route that would require it to make one stop en route.

C-130B Move Clouds Logair Haul

By David H. Hoffman

Marietta, Ga.—Lockheed Aircraft Corp.'s decision to scrap certification of the C-130B Hercules turboprop freighter has clouded the question of which aircraft and which carriers will haul Logair "outsize cargo" during the next three fiscal years.

In July, Zantop Air Transport, an uncertificated carrier based in Detroit, won a $5,289,409.96 contract to haul bulky Air Force hardware along route patterns totaling 4,878,200 stat. mi. (AW July 4, p. 40). To qualify for the award, Zantop agreed to purchase five C-130Bs—the only production aircraft meeting all of Air Materiel Command's requirements for an outsize cargo-carrying transport.

According to Lockheed, Zantop had signed a letter of intent that promised consummation of the $16 million C-130B purchase contract not later than July 31. About four days after this deadline expired, Lockheed halted its Hercules certification program.

A deadlock over how the Hercules purchase would be financed ended Lockheed-Zantop negotiations, the manufacturer told AVIATION WEEK. The line taken by Lockheed in refusing Zantop liberal terms was further underscored on Aug. 10 when Board Chairman Robert E. Gross announced a first half loss of $55,409,000 (AW Aug. 15, p. 51).

Meanwhile, Zantop has been fulfilling its Military Air Transport Service contract—which became effective on July 1—with Douglas C-54s. But the carrier can continue to do so only until Mar. 31, 1961, when the contract calls for the introduction of the first C-130B. Zantop, therefore, must reach an accord with Lockheed well before Mar. 31 if it is to have the Hercules on hand in time to avert a default.

Observers following Logair developments hold that the carrier faces an uphill climb in its efforts to obtain the turboprop freighters. Even after Zantop attracts the strong financial backing needed to satisfy Lockheed, they explain, the problem of prompt delivery remains.

On the other hand, Zantop probably could comply with the contract if:

- **Air Force-owned C-130Bs** were allocated to the carrier under a bailment agreement.
- **Federal Aviation Agency** expeditiously granted Lockheed a new type of "turbine powered, cargo only" certificate for the C-130B or waived certification requirements entirely for C-130Bs used on the Logair mission.
- **Department of Defense** approved a diversion to Zantop of C-130Bs now being assembled for the Air Force.
- **MATS extended** its Mar. 31 deadline.

Admitting that the C-130B situation was "unresolved" and that active negotiation with Lockheed was "at a standstill," President Howard W. Zantop told AVIATION WEEK that his efforts to arrange a timely Hercules purchase would continue.

Speculation that MATS was entertaining new industry proposals to fly Zantop outsize cargo routes was touched off last week when Riddle Airlines exercised its option to acquire two additional AW 650 four-turboprop freighters. Riddle, with seven of the Armstrong Whitworth transports on order and with delivery of the first expected this month, holds a second Logair outsize cargo contract. The AW 650, however, lacks the specified range and gross weight to substitute for the C-130B along the routes now flown by Zantop.

Czech Canadian Service

Czechoslovak Airlines plans to extend scheduled service to the North American Continent early next year, flying from Prague to Montreal via Amsterdam. Service will begin after delivery of SCA's fifth Soviet Il-18 turboprop transport.

CSA spokesmen there say Trans-Canada Air Lines has agreed to pool service on the transatlantic route and that negotiations between the two carriers should be completed within the near future. CSA says it will later augment the service with the use of turbojet aircraft.

Way Cleared for Fast Capital Merger Ruling

Washington—Civil Aeronautics Board has cleared the way for a fast decision on the proposed Capital Airlines-United Air Lines merger by denying requests of five other carriers for an expansion of the scope of issues at stake.

In its order denying the motions, the Board said such action would raise complex questions beyond the scope of the merger issues and "might well result in a proceeding involving a remaking of the airline map east of the Mississippi River." Delta, Eastern, National, Northwest and Allegheny filed the motions and petitions.

"The Board has stated that it is in the public interest that uncertainties and temporary restrictions upon the full and normal activities of management, stockholders and employes covered by a merger proceeding should be terminated as promptly as possible consistent with orderly and proper procedure," CAB said.

It said that questions pertaining to the transfer of Capital's routes to another carrier or the suspension of such routes should not be considered in the merger proceeding. It noted that it had "continuing jurisdiction . . . to invoke such powers whenever it is deemed necessary." Member Alan S. Boyd dissented on grounds that routes should be considered in the proceedings.

As a result of the denial order, the Board will meet its target date of Oct. 19 to start the merger hearings.

Clerks Union Strikes Braniff International

Dallas, Tex.—Brotherhood of Railway Clerks last week struck Braniff International Airways in support of demands for a new contract which the union claims is primarily to take care of wage inequities, although the airline's management claims that the real issue is institution of a union closed shop.

Railway Clerks union, representing some 2,300 Braniff personnel in 38 cities, has been working under terms of a contract which expired last December. Negotiations with the airline broke off Aug. 26 and a strike was started Sept. 26, with picketing enacted through the system.

The union says that it is seeking an agreement similar to one it recently negotiated with Pan American World Airways, which it says gave its members general wage increases of 55 cents per hour in contrast with the 34 cents per hour it says Braniff is offering. Braniff put the wage increases in effect the day the union struck. Other demands are for allowances for longevity, severance pay and cost of uniforms, in addition to across-the-board wage increases.

Braniff reports that it has provided wage increases retroactive to Jan. 1, 1960, with additional increases planned for Jan. 1, 1961 and Jan. 1, 1962.

CAB to Investigate Southern Airways

Washington — Civil Aeronautics Board bureau of enforcement said last week it will investigate Southern Airways as the result of a complaint filed with the Board by the Air Line Pilots Assn. charging that the carrier was in violation of its certificate by refusing to settle a labor dispute.

The investigation will be conducted to determine whether any such violation has been committed. Southern answered the ALPA complaint, filed in July, by stating it had used every reasonable effort to reach an agreement with ALPA.

ESSO

WING TIPS

FIX NICKS. Check metal propellers regularly for nicks and have them filed smooth as soon as possible. Nicks can develop into cracks, and cracks can result in the breaking of blades while in flight.

SET TIGHT. When checking the oil, make sure the dip stick is set in place securely. If it isn't in tight, the stick can work loose and oil may spray over the plane, causing serious loss of oil and a hazardous flying condition.

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BAC 107's Future Hinges on Sales Study

London – British Aircraft Corp.'s future decision to build its BAC 107 short-haul jet transport will hinge on the company's current worldwide survey of probably the most lucrative commercial aircraft market still unsold.

BAC is aiming at the Vickers Viscount-Convair 440 replacement market plus a near-guarantee of a substantial order from the Royal Air Force for a communications and crew-training aircraft to replace its Vickers Varsities.

Both BAC and A. V. Roe, Ltd., with its Model 771, are competing for orders that could total in the hundreds. Both companies have tackled the engineering problems with similar airframes and layouts and with identical Bristol Siddeley BS.75 turbofan engines, rear-mounted similar to the Sud Caravelle.

Model 771 specifications are firm enough for Avro to begin its detail design work (AW Sept. 5 p. 43). But BAC is selling a rough specification, expecting to refine it after ". . . we have taken everybody's views on board."

BAC 107 short-haul jet is aimed at Viscount-Convair 440 replacement market, can carry 55 passengers on 500-mi. stage length. Powerplants are Bristol Siddeley BS.75 turbofans.

Selling Points

Two major selling points are emphasized by BAC: low first cost of the airplane—about $1.4 million—and calculated seat-mile costs claimed better than those of the best propeller-driven short-haul transports. For a 1,200 stat.-mi. partial-payload route segment, BAC says the seat-mile cost would be 1.2 cents, rising to 1.5 cents for a 200-mi. stage length. With full load of 55 tourist-class passengers, design stage length is 500 mi.

When BAC's teams report back, the company will make its decision whether or not to go ahead with commercial development, but a spokesman emphasized that the decision would not depend on an initial batch of orders off the drawing board.

Gross weight and dimensions of the BAC 107 are similar to those of the Convair 440. Current design figure for the 107 is 48,500 lb. gross weight. Over-all length is 87 ft. 11 in., and wingspan is 81 ft. 8 in. Wing area is 825 sq. ft.

Engine Data

Engine data is also claimed to be impressive. The powerplants develop 7,350 lb. static thrust each, and have a thrust-weight ratio of five. Static sea-level specific fuel consumption is 0.508 lb./lb./hr. and cruising consumption is specified at 0.76 lb./lb./hr.

Bristol Siddeley has designed the engine around a turbine system similar to that used in the company's Proteus turboprop, which now has a 2,400-hr. overhaul life, and a fan adapted from the first three stages of the Olympus turbojet. The engineers believe these choices will increase engine time-between-overhaul rapidly.

Engine compression ratio is 13:1, and the fan ratio is 1.75:1.

Seating arrangement remains quite flexible at this stage; data available in London and New York to the airlines differs somewhat, and one brochure contradicts itself in the dimension of seat pitch. But one arrangement uses 11 rows: four abreast for a first-class configuration of 44 passengers, and five abreast for tourist class with 55 passengers. This layout puts one row at each of the plane's 12 in. x 17 in. elliptical windows.

Standard Layout

Passenger, freight and crew compartments are pressurized to 7 psi. The standard layout locates the galley, baggage holds and two toilets aft of the passenger cabin.

Aerodynamic differences between the BAC 107 and the Avro 771 center on the degree of wing sweep. BAC has traded cruise performance—at Mach 0.75 instead of Avro's Mach 0.82 cruise—for short-field performance without leading-edge flaps. Sweepback of the BAC 107 wing is 20 deg. and its aspect ratio is eight, chosen to meet engine-out climb requirements. There is a simple high-lift flap system and no leading-edge devices. BAC claims an approach speed of 110 kt. at maximum landing weight.

Structure and systems of the transport are conventional and manual controls are used throughout. Wing features a continuous three-section torsion box structure with integral tankage for 2,676 U. S. gal. of fuel.

Basic concept of the BAC 107 dates back three years to a design study by Hunting-Percival. Then it was a 40-to 48-passenger transport powered by a pair of Bristol Orpheus engines and weighing about 41,500 lb. When Hunting was absorbed into the BAC grouping, the design went along also, and was used for the BAC 107.

Growth set in, and so did detail changes. The weight and capacity increased, the engines changed and grew in thrust, and the fuselage was widened by a few inches to 10 ft. so that five-abreast seating could be installed. The horizontal tail was raised based on Vickers' wind-tunnel work on the VC. 10 transport and experience with the mid-position layout of the Valiant bomber.

About all that remained was what one engineer called the "cutdown Caravelle" layout.

Airline Views

Airline engineers questioned in the U. S. by Aviation Week agreed generally that the size and performance of the two British contenders were ideal for American carriers with high-density short-haul route segments. One of them added that he wasn't convinced of the short-field capability of either type yet, and any choice he ever had to make would be influenced greatly by that performance factor.

Biggest hazard to sales of either the BAC or the Avro design is the time lag between the presentations now being made by both companies and the delivery dates of the airplanes themselves if ordered. If the world's airlines jump at the design, the future is bright; if they delay for financial or other reasons, both BAC and Avro will find themselves with tough competition by the time the field really opens up for sales.

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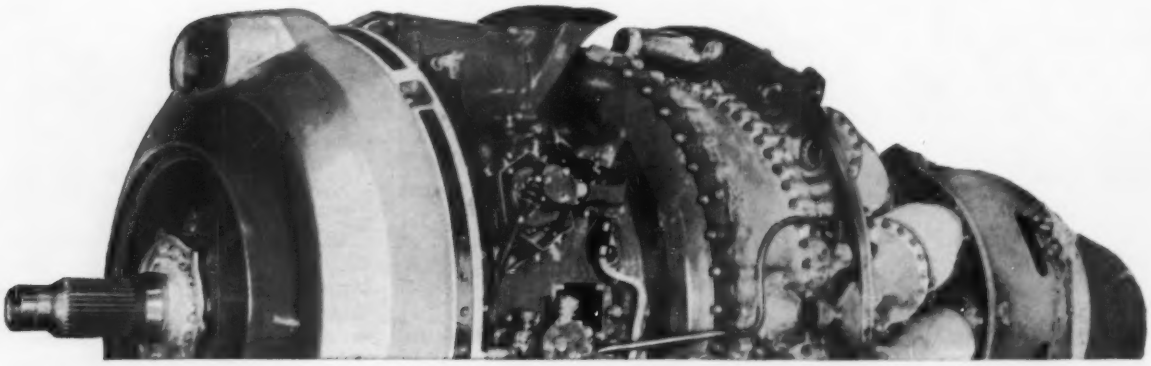

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American Turbofan-Powered 707-120B Reaches Mach .95

Flight view of first American Airlines Boeing 707-120B powered with Pratt & Whitney JT3D turbofan engines shows large inlets and enlarged cowlings (AW Sept. 26, p. 44). Airplane has flown more than 100 hr. in tests (AW July 11, p. 45) and has reached Mach .95 speeds. Boeing says certification tests will be completed at the end of the year.

General Dynamics Writes Off Jet Cost

New York—General Dynamics joins the ranks of other U. S. commercial jet transport producers with its decision to write off as of the third quarter the total anticipated charges against earnings of its Convair 880 and 600 programs.

The pre-tax write-off taken in the third quarter totals $96.5 million which includes:

- **Provision of $16.1 million** for future research and development expenses. Technically this is not a write-off at all, but is similar to provisions made for future income taxes. It includes estimates for such costs as certification of the Convair 880-M and the Convair 600.
- **Excess of $66.4 million** in manufacturing costs over proceeds from sales. Convair had been writing down these costs on the basis of orders it estimated it would receive, but the current write down is on the basis of the 94 airplanes actually sold. These 94 airplanes will thus be delivered on a breakeven basis, but any future orders will be on an inventory profit basis.
- **Write down to salvage** value of used airplanes acquired in connection with sales of jet transports—totaling $14 million.

Included in the total are charges Convair is incurring while the Convair 880s ordered by Howard Hughes for Trans World Airlines remain in inventory.

General Dynamics' objective in the write-off method was to ensure as much as possible that there would be no further charges against earnings to report on the programs, though there is no attempt to include provision for unforeseen costs that have cropped up repeatedly in the programs of other manufacturers.

Like other manufacturers, Convair has found development and manufacturing costs of the jet programs have significantly exceeded initial estimates (AW May 2, p. 177). Total pre-tax charges for the entire program for Convair amount to $221.5 million.

As a result of the charges against earnings, General Dynamics will show a net loss of approximately $26 million for the nine months ending Sept. 30. With the costs thus charged off, the company expects a profitable fourth quarter, but directors cut the quarterly dividend from 50 cents to 25 cents because of the deficit.

Lear Backing Jet Executive Plane

Zurich—Federal Aviation Agency officials are scheduled to arrive here on Oct. 11 to work out details of FAA certification tests for a six- to seven-passenger twin-jet executive transport being financed largely by U. S. industrialist William P. Lear, Sr.

Lear, who has organized a Swiss-American firm to market the aircraft in the U. S., plans first deliveries sometime in 1963 at a retail cost of $250,000.

Wind tunnel tests on the aircraft have been completed and Lear hopes to roll out the first prototype by December, 1961. The new company that will handle marketing in the U. S. has been named the Swiss American Aviation Corp. and is incorporated in Delaware.

The aircraft, designated the SAAC 23, is being designed for a cruising speed of 535 mph. at 30,000 ft., with a range of 1,500 mi. against a 60 mi. headwind plus 45 min. holding time over the terminal field.

The aircraft is to be powered by either two General Electric 2,450 lb. thrust J85 engines derated to approximately 2,000 lb. thrust each or two 1,700 lb. thrust Continental J69 turbojets and is being designed to operate from 2,500-ft. runways. Original design was evolved by a team under Dr. Hans Studer. Studer, formerly of the Swiss aviation firm Flug-und Fahrzeugwerke A. G., is now a member of the board and delegate for the technical management of Aviation Development, Inc., a new company incorporated here as essentially the Swiss arm of Swiss American Aviation Corp.

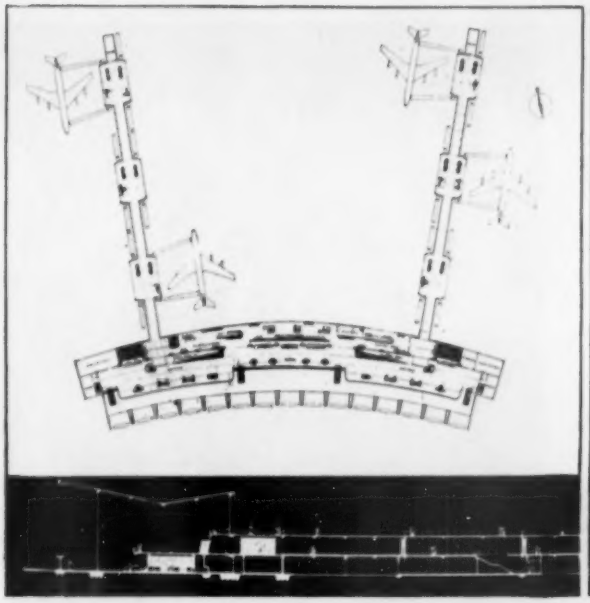
A low-wing design, the SAAC 23 will have a fuselage length of approximately 37 ft. and a wing span of about 35 ft., under present plans. Powerplants will be mounted one on either side near the rear of the fuselage.

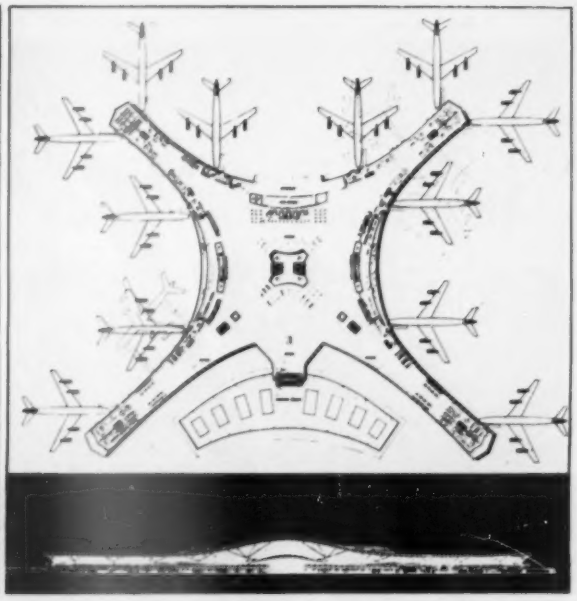
Lear, board chairman of Lear, Inc., plans to subcontract the airframe production with several European manufacturers, then ship the airframe to the United States where individual distributors will be responsible for installation of engines and some instrumentation as well as interior decoration. This plan eliminates the cost of shipping powerplants and instrumentation from the United States to Switzerland and then back to the U. S. in a completed aircraft. Two prototypes, however, will be assembled in Switzerland by Flug-und Fahrzeugwerke for flight test and FAA certification.

Airline Income & Expenses–2nd Quarter, 1960

	Passenger Revenue	U. S. Mail	Property*	Charter	Federal Subsidy	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNK								
American	97,387,543	1,906,065	7,985,672	297,578	.....	107,932,094	99,443,347	8,005,421
Braniff	18,196,848	513,506	958,920	97,089	.....	19,804,287	18,569,737	913,225
Capital	26,785,694	644,838	1,055,457	73,488	.....	28,559,606	28,702,651	−765,761
Continental	14,192,713	222,681	565,293	42,692	.....	15,188,830	13,381,748	980,736
Delta	30,644,155	545,783	1,877,990	84,458	.....	33,445,211	28,794,864	3,870,459
Eastern	57,215,357	1,185,615	2,565,744	173,409	.....	61,632,889	66,109,810	−5,046,799
National	16,136,811	311,719	943,814	329,302	.....	17,368,840	18,465,430	−1,353,827
Northeast	9,340,160	129,827	416,706	18,374	.....	9,997,065	10,232,803	−635,888
Northwest	19,559,307	641,212	1,630,485	34,585	.....	21,917,203	21,253,594	263,630
Trans World	65,179,446	1,502,837	3,610,416	414,062	.....	71,162,700	70,198,319	1,293,662
United	78,853,809	2,907,206	6,205,989	553,271	.....	89,285,514	84,221,000	6,162,788
Western	14,142,472	327,340	602,635	74,419	.....	15,257,373	14,440,101	813,822
INTERNATIONAL								
American	1,401,397	10,025	169,208	.....	.....	1,652,437	1,742,585	−90,177
Braniff	2,377,139	49,665	248,333	50,908	.....	2,775,883	2,812,493	−83,815
Caribbean-Atlantic	779,995	8,448	41,695	7,898	.....	852,256	776,182	74,770
Delta	907,427	12,963	62,538	2,432	.....	988,975	1,114,772	−114,567
Eastern	6,505,436	140,019	262,509	99,582	.....	7,016,566	6,985,685	−86,302
Mackey	463,921	.....	14,472	28,336	.....	511,721	503,338	10,145
National	301,637	2,720	27,307	20,325	.....	354,477	523,922	−180,845
Northwest	6,131,704	1,786,655	1,258,491	103,086	.....	9,543,421	9,213,061	147,778
Pan American Combined	84,544,657	5,205,452	11,268,913	2,249,857	.....	105,682,230	95,138,749	8,938,920
Alaska	1,313,053	51,448	151,862	51,971	.....	1,579,202	1,514,022	130,208
Atlantic	40,829,297	2,151,371	4,367,054	1,442,545	.....	49,323,090	41,955,374	7,279,690
Latin America	18,837,220	630,324	3,734,324	555,870	.....	24,843,727	27,846,945	−2,657,243
Pacific	23,565,087	2,372,309	3,015,673	199,471	.....	29,936,211	23,817,308	6,264,873
Panagra	3,245,155	162,977	755,323	11,238	.....	4,481,696	5,126,295	−147,181
Resort	.....	.....	.....	1,270,786	.....	1,276,986	1,280,278	−205,200
Trans Caribbean	1,493,886	.....	163,191	111,423	.....	1,826,942	1,531,059	373,317
Trans World	24,716,146	1,871,515	1,640,081	726,080	.....	29,953,078	21,390,735	8,572,119
United	5,535,620	164,045	137,057	.....	.....	5,868,241	3,953,829	1,791,570
Western	1,171,343	8,836	44,566	.....	.....	1,235,803	1,087,298	134,452
LOCAL SERVICE								
Allegheny	2,604,255	28,066	147,710	7,992	846,025	3,653,082	3,778,907	−217,972
Bonanza	1,096,270	20,124	37,922	22,130	564,096	1,751,886	1,865,945	−181,575
Central	627,883	19,594	33,047	2,122	688,096	1,379,852	1,432,271	−56,241
Frontier	1,552,104	41,815	118,643	30,937	1,889,771	3,673,518	3,337,766	292,914
Lake Central	751,829	19,031	36,226	1,588	431,175	1,242,015	1,203,282	28,296
Mohawk	2,318,551	37,501	75,673	41,968	476,316	2,979,098	3,120,514	−276,924
North Central	3,268,273	92,480	154,277	22,450	2,225,611	5,775,478	5,302,851	422,390
Ozark	1,992,847	38,281	131,796	4,040	1,300,781	3,492,475	3,158,898	291,804
Pacific	1,620,203	33,620	31,401	202,794	589,530	2,485,469	2,974,943	−561,672
Piedmont	1,953,442	30,539	78,449	51,110	959,254	3,114,156	3,066,031	−7,776
Southern	880,203	32,579	51,252	3,174	501,963	1,473,928	1,774,147	−310,443
Trans-Texas	1,352,560	53,864	83,988	23,165	711,845	2,234,517	2,197,785	36,062
West Coast	1,569,844	27,747	42,188	5,534	927,277	2,583,248	2,840,957	−330,029
HAWAIIAN LINES								
Aloha	1,181,146	6,207	27,892	1,689	.....	1,246,413	1,261,015	−55,356
Hawaiian	1,629,195	10,284	231,803	911,715	.....	2,829,268	2,717,463	44,839
CARGO LINES								
AAXICO	.....	.....	.....	2,788,702	.....	2,854,738	2,170,685	785,087
Aerovias Sud Americana	.....	.....	303,424	458,460	.....	761,859	727,654	23,186
Flying Tiger†	.....	.....	.....	.....	.....	.....	.....	.....
Riddle	.....	29,278	1,124,535	134,908	.....	1,292,426	1,901,313	−578,678
Seaboard & Western†	.....	.....	.....	.....	.....	.....	.....	.....
Slick	.....	.....	.....	3,871,073	.....	3,941,439	3,639,480	420,976
HELICOPTER LINES								
Chicago Helicopter	528,612	9,377	2,968	1,680	453,957	997,126	830,536	178,564
Los Angeles Airways	62,429	38,060	51,120	289	227,205	379,990	352,453	27,488
New York Airways	288,468	16,587	19,724	7,363	537,330	874,021	909,185	−47,812
ALASKA LINES								
Alaska Airlines	629,534	189,640	171,015	603,532	403,374	2,056,030	2,015,588	184,437
Alaska Coastal	301,192	30,488	37,906	11,344	148,461	539,702	573,716	−40,887
Cordova	43,312	23,540	31,310	110,752	106,504	317,526	308,944	4,604
Ellis	218,025	14,265	24,234	2,679	98,204	362,325	329,105	39,445
Northern Consolidated	246,182	151,323	123,309	55,071	186,982	769,186	767,588	−32,862
Pacific Northern	1,944,705	205,088	346,259	15,828	465,429	3,012,035	2,809,597	163,748
Reeve Aleutian	444,604	113,111	113,178	65,796	.....	749,284	584,111	155,428
Western Alaska	19,655	5,363	3,216	9,107	16,914	54,848	53,656	819
Wien Alaska	305,122	191,874	116,818	195,793	751,320	1,586,518	1,255,916	294,690

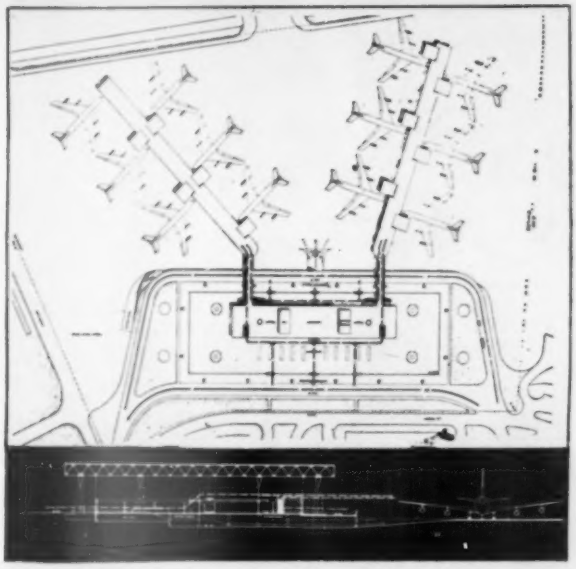
* Property figure includes express, freight & excess baggage revenues. † Not available.
Compiled by Aviation Week from airline reports to the Civil Aeronautics Board.

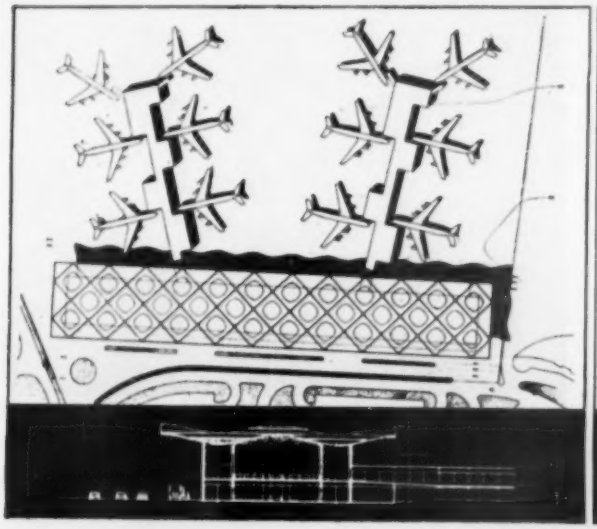


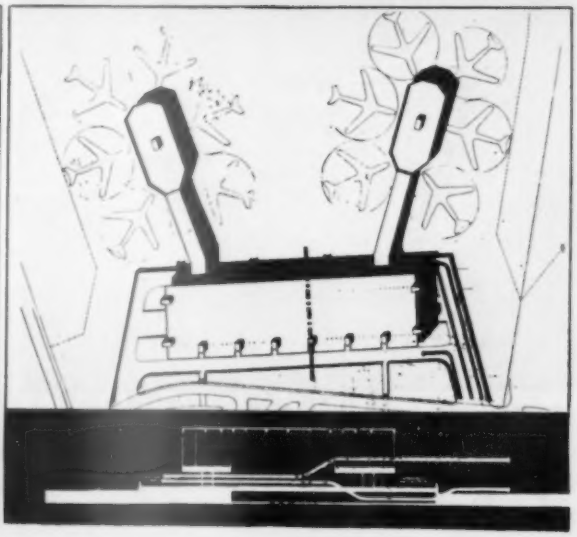


Architects' Competition Produces Varied Designs For Terminal at Idlewild

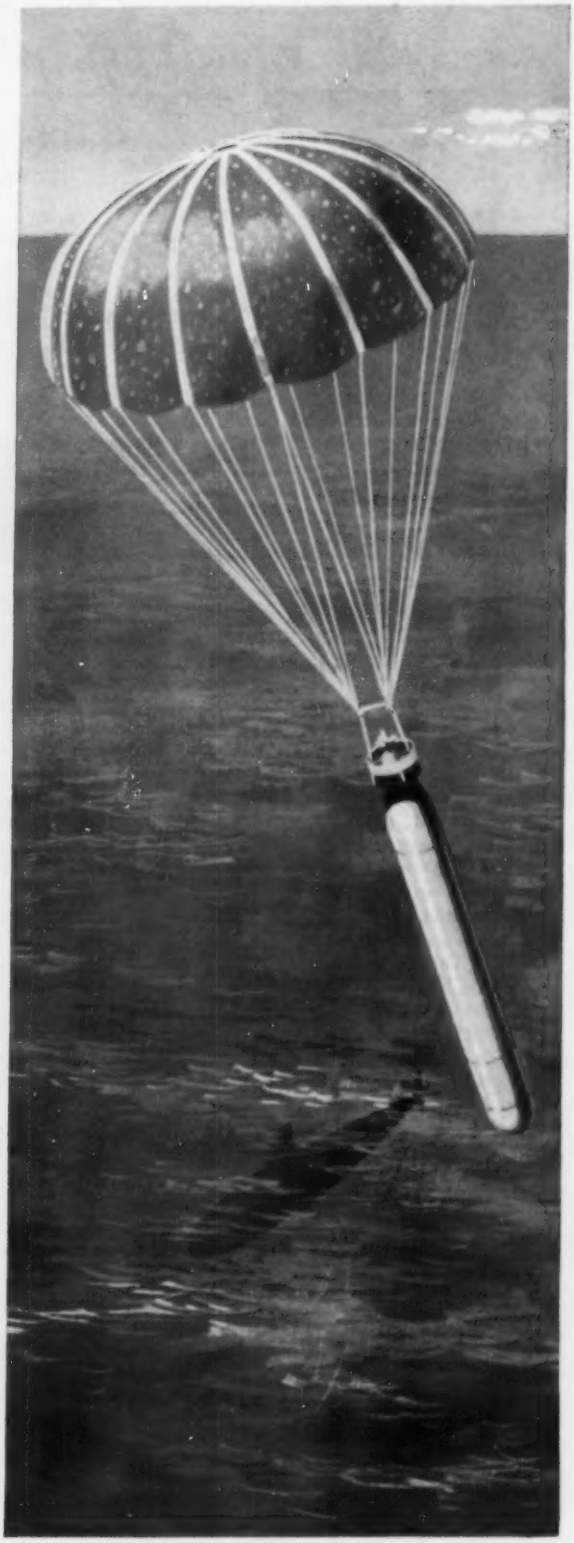
Five approaches to designing a "union terminal" to accommodate airlines without their own New York International Airport terminals were submitted by architects in a recent Port of New York Authority competition. Winning design (right) is by I. M. Pei. Contest was only to select the architect; final design may differ from that pictured. Entrants in addition to Pei were Arvin Shaw of Carson and Lundin (above, left); B. Sumner Gruzen of Kelly and Gruzen (above, right); Philip Johnson (below, left); and Morris Ketchum, Jr., of Ketchum and Sharp. Specifications for a building on a 22-acre site included 12 gate positions, minimum 60,000 sq. ft. of waiting room space, 12,000 sq. ft. of baggage claim area, 1,100 ft. of ticket counter. Winning design calls for a 600-ft.-long rectangular building. Probable cost: over $9 million. Construction may begin next year.







1. Within seconds after detecting an enemy submarine, a shipboard computer automatically charts the sub's course, range and speed . . . then aims the missile launcher. Upon command, a rocket-propelled ballistic missile is fired.



2. The missile follows a ballistic trajectory, shedding its rocket motor and airframe before water entry. When the payload is a torpedo, a parachute blossoms in flight to slow the missile's plunge into waters near the target.

3. After hitting the water, the ASROC torpedo becomes activated by the energizing of a sea-water battery. Then, the missile begins an acoustical homing search from which it locks onto its target and pursues it to destruction.

Swift and precise sequential control of Honeywell's ASROC provides the first long-range anti-submarine weapon

From initial sonar detection through firing and ultimate target contact, ASROC's automatic system delivers an unerringly destructive missile from thousands of yards away—all in a matter of seconds!

Development of ASROC started with an idea and tens of thousands of unanswered questions. Hoping to find the answers, the Bureau of Naval Weapons gave Honeywell, as prime contractor, the responsibility of designing, developing, testing and producing the entire system under technical direction of the Naval Ordnance Test Station.

The ASROC concept was based on present knowledge at the time the program was initiated, but it remained for exhaustive test programs, carried out by the Navy-Honeywell team, to develop ASROC from idea to hardware.

Early in the program, prototype missiles were test fired statically and from moving platforms at the Naval Ordnance Test Station to obtain aerodynamic research information. Engineers measured, recorded and computed items and distances for thrust termination, airframe separation and payload impacts.

Hydroballistic information was obtained from dummy payloads fired into the water from a test stand and dropped from airplanes into a hydrophone range. Calculations on trajectory, hydrodynamic stability and depth-time ratios contributed to design. Throughout the development program, more than 200 test firings were conducted.

The result is an integrated weapon system consisting of an underwater sonar detection device, an electronic digital fire-control computer, a missile launcher, the ASROC missiles and all necessary training equipment.

The facilities of 14 Honeywell divisions are available for development of any complex control problems of missile or aircraft systems and components. If you have a problem in the design of systems or components, call or write: Honeywell, Military Products Group, Minneapolis 8, Minn. In Canada, write: Honeywell Controls, Limited, Vanderhoof Avenue, Leaside, Toronto 17, Canada.

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AIRLINE OBSERVER

► Lockheed Aircraft Service and Douglas Aircraft Co. competition to convert Douglas DC-7s to freighter configuration rapidly is developing into a full-fledged sales battle. Riddle Airways is the latest customer to feel the impact of this stiff competition. Holding an option to acquire up to seven DC-7Cs from General Aircraft and Leasing Division of General Dynamics, Riddle is shopping both Lockheed and Douglas before placing its $250,000 per aircraft order.

► Riddle Airlines will increase its purchase of five AW 650 Argosy air-freighters from Armstrong-Whitworth Aircraft by two airplanes. First aircraft is slated for delivery late this month or early in November.

► Eastern Air Lines is showing serious interest in the Boeing 727—proposed transport powered by three aft-mounted turbofan engines. Two engines are being considered: AR 963, Allison-built version of Rolls-Royce RB-163 bypass engine, and Pratt & Whitney JT8D-1, turbofan version of J52.

► Federal Aviation Agency is considering revision of its current monthly flight time limitations for air crews. Recent talks with airlines have centered about the greater hours permitted international flights compared with domestic operations. Purpose is to see if any change is needed in present rule which permits 100 hr. a month for a domestic crew of two pilots and a third crew member, compared with 120 hr. for the same crew on foreign flights.

► Czechoslovakia has protested International Civil Aviation Organization decision to adopt VOR/DME air navigation system as a universal standard. Although Czechoslovakia is a member of ICAO, the country cannot buy the equipment because the system is used by NATO and is thus banned from export to Communist bloc countries.

► International Air Transport Assn. will continue its fight to ban the use of credit cards, other than Universal Air Travel Plan cards or airline cards, from international air travel. Civil Aeronautics Board recently disapproved an IATA resolution prohibiting the use of outside credit cards. To discourage the spread of outside credit facilities, IATA has now submitted for CAB approval a modified resolution which stipulates that no fee or commission should be paid to outside credit organizations on credit for air travel sold. Modification, if approved, would automatically eliminate such large credit card groups as Diners' Club, American Express or Hilton Carte Blanche from entering international air travel field, since they charge a fee for each credit transaction.

► Japanese Transportation Ministry has received government approval to expedite bilateral talks with Britain, West Germany and Italy as a first step toward extending Japan Air Lines routes to London through Europe. Talks with the British began late last month. Once European routes are established, Japanese will open negotiations with the U. S. for operating rights into New York.

► Plans to market the Dassault Communaute twin-turboprop executive transport in the U. S. and Canada will be developed by a group of U. S. businessmen (AW June 27, p. 94). Canadair also has expressed some interest in building the 6-8 passenger aircraft under license.

► Red China has started a new civil airline that links Shenyang, capital of Liaoning Province, and Chaoyang, a rapidly growing city in western Liaoning. The provincial airline operates a Chinese-built An-2 type transport over the route on a regular three times weekly service.

► KLM will join Scandinavian Airlines System and Swissair in the pool agreement originally established by the latter two carriers.

► South American governments are scheduled to meet Oct. 24 in Montivedeo in another attempt to stabilize rates and fares on South American routes. Regional capacity restrictions, now imposed on foreign carriers by some governments, are also included on the agenda.

SHORTLINES

► **Aeroflot**, the Soviet state airline, has established its eighth college-level training institute at Riga, Latvia. The new school will train about 450 engineers annually.

► **Air Traffic Control Assn.** will explore the prospects of forming an international federation of air traffic control associations when it meets in San Francisco Oct. 3-5 for its annual convention. Agenda includes an "international air traffic control conference," and ATCA invitations have been accepted by 22 nations.

► **Air Transport Assn.** reports scheduled helicopter service in Chicago, Los Angeles and New York posted a 44.4% gain in revenue passenger miles during the first seven months of 1960 over the same period in 1959. Total passenger miles were 5,606,000 this year, compared with 3,883,000 last year. The three helicopter carriers carried 290,000 passengers in the seven month period this year, compared with 185,000 in 1959, a gain of 56.8%.

► **Continental Air Lines** has received Federal Aviation Agency approval to increase time between overhaul on its Pratt & Whitney JT3 turbojet engines from 1,200 hr. to 1,400 hr. Several other airlines have received approval for time between overhauls of 1,300 hr. Continental also has just completed 5,000 hr. overhauls of two of its Boeing 707 turbojet airliners.

► **Japan Air Lines** is scheduling inaugural Seattle-Tokyo-Hong Kong Douglas DC-8 turbojet service via the Great Circle route for Nov. 1, subject to Japanese government approval.

► **Northeast Airlines** carried 1,374,900 passengers over its routes during the year ending Aug. 31, a 16.9% increase over the same period last year. The carrier flew over 553,114,000 revenue passenger miles in the same period.

► **Trans World Airlines** has established a Military Transportation Department to coordinate all TWA activities relating to military passenger transportation and contract cargo work for the U. S. government.

► **United Air Lines** carried 1,350,000 passengers in its fleet of Douglas DC-8s and Boeing 720 airliners during its first year of turbojet operations, which ended Sept. 17. The airline said that it flew 1,875,000,000 revenue passenger miles during this period and that turbojets now account for more than half of its daily airlift.

CARAVELLE

The finest medium range jetliner the world over

Profit maker even on low density routes

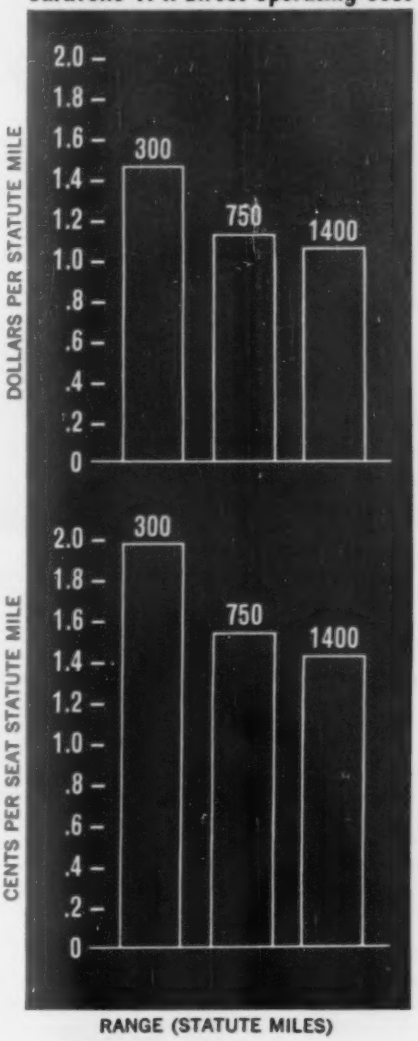
Caravelle can make profits with one-third fewer passengers than any other jet at 500 statute miles. And whether the route is short or medium range, if the passenger potential is low, Caravelle's profit-making potential is outstanding.

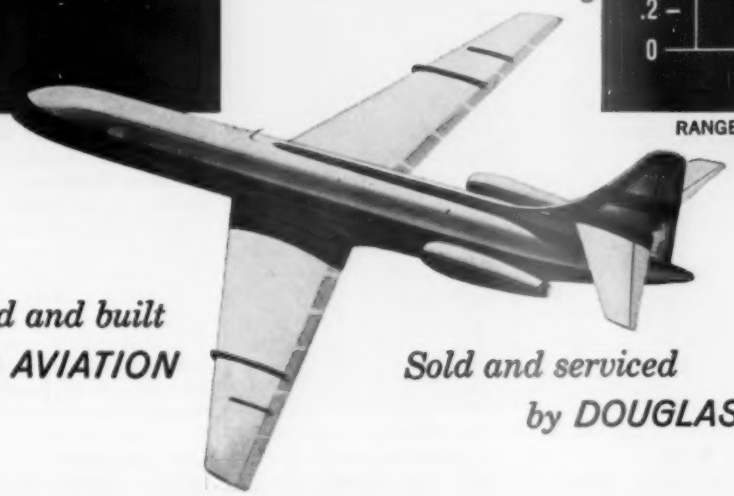
These economy factors are illustrated in the charts on the right, which are based on ATA cost formulae.

Caravelle's additional advantage is that it can get in and out of airports that serve low traffic areas. It has the shortest runway requirements of any jetliner.

Caravelle has established an outstanding reputation in regularly scheduled airline service in Europe. It will begin service in the United States in 1961.

Caravelle VI R Direct Operating Cost





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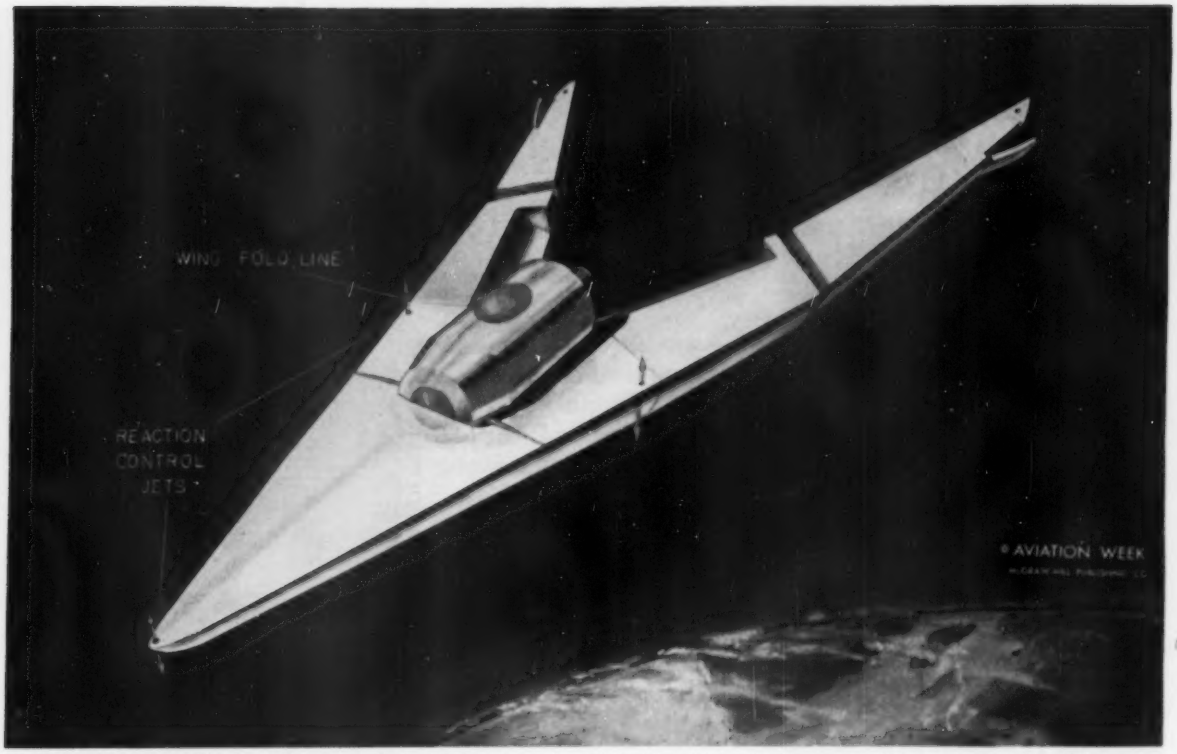


MANNED SPACE VEHICLE, designed jointly by Hughes Aircraft and Lockheed Aircraft, shown in artist's concept, will be able to carry a pilot and up to three passengers to rendezvous with friendly satellites and space stations or to intercept potentially hostile satellites.

Anti-Satellite Techniques Investigated

Washington—Mounting concern over the development of reconnaissance satellites or even armed nuclear bombardment satellites is causing major space technology companies to take an early hard look at methods of detecting, tracking, intercepting and finally destroying potentially hostile satellites.

In the belief that such an anti-satellite capability inevitably must be acquired, many companies have been investigating problems associated with defense against satellites for some time. One ambitious plan, conceived jointly by Hughes and the California Division of Lockheed, spells out in detail a satellite rendezvous vehicle, originally intended as a space ferry to service manned space stations. The Hughes/Lockheed effort, like many others, is internally funded and rather modest in size although a few have or have had limited government funding.

First major step in military support of programs expected to evolve from these early studies, however, probably will be the award of Project Saint, a program intended to provide the capability necessary for rendezvousing with, inspecting and possibly destroying satellites (AW Sept. 26, p. 30). The handful of previous small military studies have probed possible rendezvous vehicle designs, detection and tracking of satellites, destruct mechanisms, etc.

Among other companies known to have actively investigated the anti-satellite area are General Electric, Autonetics, RCA, Convair, Boeing, Aerojet, Westinghouse and ACF Industries.

One obstacle, aside from the sizable technical hurdles blocking the development of a rounded defense against sophisticated satellite systems, is a major political issue involving the relations between nations in outer space. International law does not govern conduct of nations in space. Consequently, some industry sources speculate, the cold war could spill over into a very hot war in outer space—with each nation attacking the other's satellites without actually precipitating armed conflict between themselves on earth. Short of this, there might be furtive efforts by either side to make foreign satellites passive by simulating destructive natural phenomena in space. Thus, an opponent might never be certain that his satellites were enemy-attacked.

Certainly, these sources insist, no major power would tolerate a potential enemy building nuclear weapon capability into a radio-command satellite system. It is even questionable, they say, whether the Russians would long permit the Iron Curtain to be pried open by an effective, high-resolution reconnaissance system without retaliating against the offending satellites. The Russians themselves may acquire the ability to intercept multiple-pass vehicles—reconnaissance, early-warning and communications satellites—by 1963 (AW Sept. 12, p. 23).

Prominent in anti-satellite thinking is the design of vehicles to rendezvous with and inspect an unknown satellite. Intercept vehicle schemes being considered are projected on the basis of contemporary technical capabilities, or those expected over the next 5-10 years. One plan, conceived by Westinghouse, calls for a rendezvous satellite, equipped

with radar for target seeking, which can either be launched with immediate intercept intentions or put into a "parking orbit," ready for command to intercept. The Westinghouse vehicle would incorporate inspection capabilities in the form of television, infrared and other radiation sensors.

The Hughes/Lockheed plan, which is pushing the state of the art by years, has been the subject since the summer of 1958 of a cooperative study by Hughes and Lockheed. Initially conceived as a method of supplying, re-equipping or exchanging personnel with manned space stations, the system concept was extended to include ability to rendezvous with a foreign satellite. The system is viewed as an expression of technological development in 1965. The Hughes/Lockheed plan envisages a manned, recoverable and reusable space vehicle capable of operating with varying payloads at orbits from 100 to 1,000 mi. above earth for periods not exceeding 24-hr. Original plans call for the preparation of a mockup of a small test vehicle sometime in 1961.

Vehicle Design

The Hughes/Lockheed vehicle as proposed will be able to transport a pilot plus 1,000 lb. of payload or three passengers to altitudes up to 1,000 mi. above the earth or proportionally greater payloads to lower altitude orbits. Payload of 14,000 lb., for example, might be placed in a lower, 300-mi. orbit.

The vehicle will be a folding arrow wing or notched delta configuration with aft portions of the wings capable of being folded back over skewed hinge lines onto forward portions into an arrowhead shape for launching with a conventional ICBM booster. After injection into orbit, the wings would unfold, giving the vehicle an arrow-wing form. Maximum weight at injection into orbit is calculated at 22,700 lb., and atmospheric entry weight is about 15,000 lb.

Folding capability, a Hughes/Lockheed study indicates, permits halving the configuration area for launching, thereby cutting destabilizing effects on the booster, and provides symmetrical loading to the booster and additional bracing for the lifting surface so it can withstand launching airloads greater than those at re-entry.

A few of the important features of the vehicle are:

- **Length**—78 ft. 4 in.
- **Wing span**—44 ft. 2 in.
- **Wing area**—1,000 sq. ft.
- **Drag rudder area per side**—15 sq. ft.
- **Elevon area per side**—85 sq. ft.
- **Mean aerodynamic chord**—29.8 ft.
- **Landing gear**—retractable nose wheel and two retractable tail skids.
- **Distance from top** of center-mounted capsule to bottom of extended nose wheel—13 ft. 2 in.

Rendezvous with a friendly satellite in an orbit of about 300-mi. height can be achieved in two vehicle orbits and would require about 3 to 4 hr., according to Hughes/Lockheed calculations. The vehicle can be launched in folded form from a three stage booster using ICBM launching techniques and guidance system. Orbit height would be determined by the guidance program. Throughout the launch phase neither the pilot nor the passengers take an active part in the operation except to actuate escape mechanisms if necessary.

The booster can inject the vehicle into orbit within 2 deg. of the desired orbit height and within 20 mi. of the target along orbit. The vehicle's wings unfold, and desired attitude can be achieved by an automatic control system or by the pilot. The target can then be located by a retractable search and ranging optical device and the vehicle maneuvered within 500 ft. of it by a maneuvering engine. Closer contact can be effected by a combination of visual observation and use of a translational and attitude space control system.

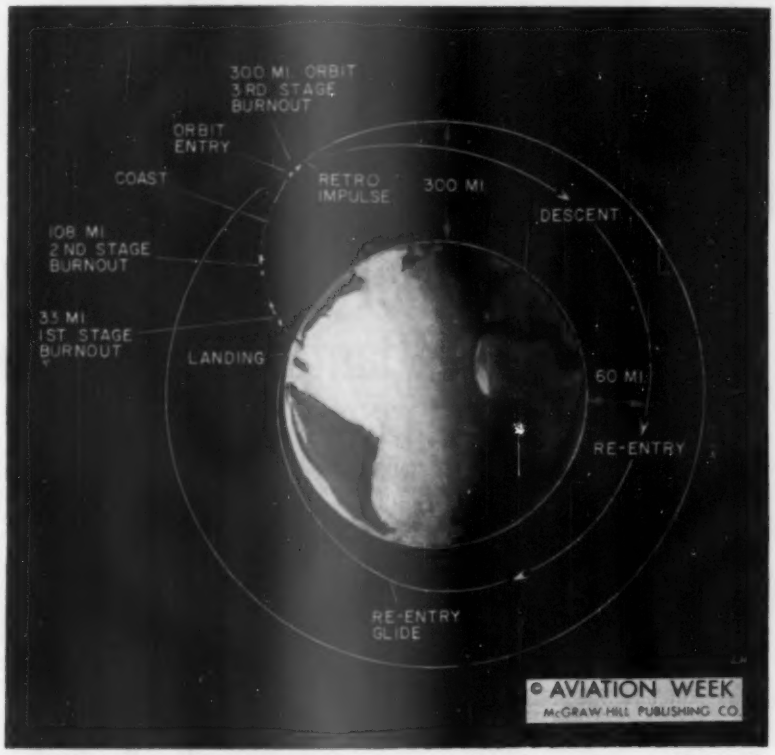
If actual physical contact is made between the vehicle and a satellite, the former can be separated from the latter by a reaction control system and oriented to proper attitude for firing of a retro impulse provided by the maneuvering engine. This impulse starts an elliptical transfer orbit which has a perigee located within the atmosphere and it also fixes the re-entry angle.

For rendezvous with a foreign satellite, the vehicle might be injected into a coplanetary orbit several hundred miles different from that of the target satellite and kept there awaiting suitable time for transfer. The vehicle would re-enter the atmosphere at a flight path angle of about 1 deg. below local horizontal and at an angle of attack of about 45 deg. An automatic flight control system (AW May 16, p. 66), employing a rate of change of skin temperature feedback loop, controls the flight path of the vehicle to minimize structural temperature. After the vehicle passes the critical heat path, the temperature control loop is disengaged and the vehicle is guided toward a desired landing location by its navigation system. Navigation inputs continue throughout glide and deceleration until the vehicle approaches the landing area at subsonic speeds. Landing can then be accomplished at an 80-kt. touchdown speed.

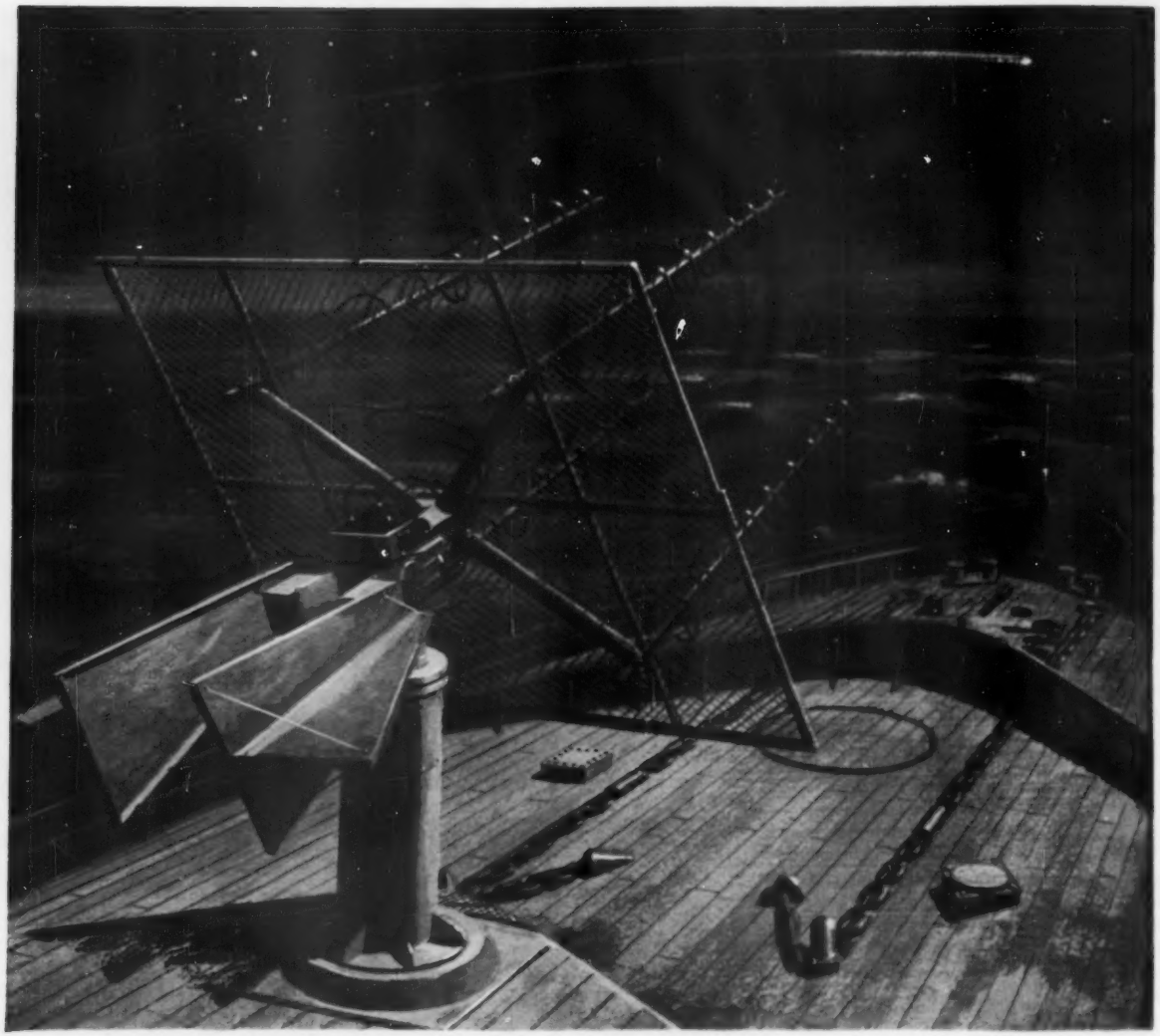
Other Characteristics

Other characteristics of the vehicle include:

- **Structure**—Heaviest loads on the structure, according to the joint study,



POSSIBLE flight path of Hughes/Lockheed space vehicle for rendezvous with friendly vehicle in space is detailed above.



2-week delivery of Cubic AGAVE for shipboard use steps up Atlantic Missile Range tracking

Faster, more accurate location of ICBM nosecones as they re-enter the earth's atmosphere and rush toward impact areas in the South Atlantic will now be possible with a new Cubic AGAVE installation. The system was ready for shipment only two weeks after the initial order was placed. Speed like this typifies Cubic's versatility and flexibility to meet fast changing missile range instrumentation requirements.

This new AGAVE is already installed aboard the American Mariner, a range instrumentation ship operated by RCA. AGAVE (Automatic Gimballed-Antenna Vectoring Equipment) is an automatic tracking antenna system that operates in the 225-mc to 300-mc band. Continuous-wave correlation detection, and the 18-db gain of the antenna array, permit reliable tracking over long ranges.

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Write for a free booklet on AGAVE, to Dept. AW-4. Cubic Corporation, San Diego 11, California.

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Anti-Satellite Kill Mechanisms

Once a foreign satellite is located and hostile intentions recognized, a variety of techniques for frustrating, making it passive or destroying it may be feasible. The problem is less difficult for multiple-pass satellites which have calculable periodic flight paths than they would be for sophisticated satellites which might have programed erratic flight paths. Kill methods which might be employed against multiple-path snooping satellites, for example, include:

- Paint spray—Camera lenses could be sprayed with paint thereby frustrating satellite mission.
- Clouds of sand, pebbles, silver, mercury or destructive chemicals—any of these might be hurled against the satellite or placed in its path to pit camera lenses, corrode solar cells or protective structures.
- Heat—Sun's rays might be concentrated by giant solar collectors and focused on the satellite to heat sensitive electronic gear beyond critical limits.
- Fields—Satellite might be subjected to crippling effects of magnetic, electric, or RF fields.
- Radiation effects—Satellite might be exposed to rate or dose effects from nuclear explosion or a nuclear reactor.
- Projectiles, blast, etc.—Projectiles might be fired through a satellite to destroy electronic or optical gear or power supplies, or detonations set off in vicinity of satellite to physically wreck sensitive gear.
- Particle beams—Beams of protons, electrons, plasmas, optical beams or electrical discharges might be used effectively against satellites.

Some of these mechanisms require greater precision in use than others; some, like RF beams and plasma, would require interceptor vehicle to be close to the satellite because of power requirements while others, like a sand cloud, might be deposited miles from an oncoming vehicle. As the capability to locate, track and destroy satellites progresses, so in all likelihood will measures for countering this capability grow. Consequently, "natural" kill mechanisms, such as the simulation of a micrometeorite shower, might be a preferred technique as an opponent could then be kept unaware of the cause of his satellite failures.

To counter anti-satellite defenses, later satellite systems may be expected to employ countermeasure techniques. An armed satellite might, for example, be disguised to look like a balloon when viewed by radar or infrared sensors. It might be silent at all times except during line-of-sight interrogation from a land base for the coordination of bombardment satellites. To identify it among many decoy balloons might require human inspection.

occur during the launch phase when the vehicle is in the folded configuration and when structural temperatures are low. On the other hand, extreme atmospheric re-entry temperatures occur at low load values. Rene 41 metal, a nickel-base alloy, or its equivalent, is the proposed structural material except for the stagnation point area where a material capable of resisting higher temperatures is needed. In this case, alloyed molybdenum (0.45 titanium), a heavier material, can be employed or other cooling methods might be provided. A truss-type structure is proposed for supporting the sandwich panels on the lifting surface. This results in a lifting surface weight of less than 2 psf. Propellant tanks form an integral part of the structure. The passenger control capsule, constructed of an aluminum inner shell and a steel outer shell (to resist corrosion and tearing) is shielded from extreme temperatures by the lifting surface.

- **Propulsion**—Thrust will be provided by a throttleable rocket engine (1,000 to 7,500 lb. thrust) burning high-concentration hydrogen peroxide and JP-4. Considerations in selecting hydrogen peroxide as an oxidizer include its storable nature, applicability either as a monopropellant or oxidizer, absence of toxicity, useful products of combustion and possible use in an auxiliary power-generating system. Situated in the V of the wing trailing edge, the maneuvering engine can be folded out of the way of the third-stage booster or so aligned that the thrust axis passes through the vehicle's center of gravity. This engine is the source of thrust for correcting navigation errors, orbit transfer and lift/drag improvement and control during landing.
- **Power**—A hydrogen peroxide turbogenerator pump provides the necessary auxiliary electric and hydraulic power for the mission. Turbine exhaust can be condensed in a heat exchanger to supply water for use as a cooling agent and free oxygen for the life support system. Reaction controls are also powered by hydrogen peroxide, so only a single oxidizer is necessary for reaction control, life support, auxiliary power and basic propulsion systems.
- **Capsule**—Pilot and possible passengers

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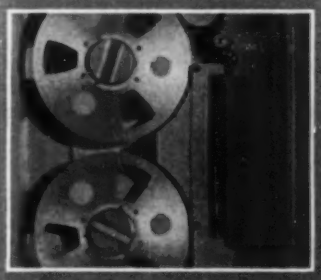

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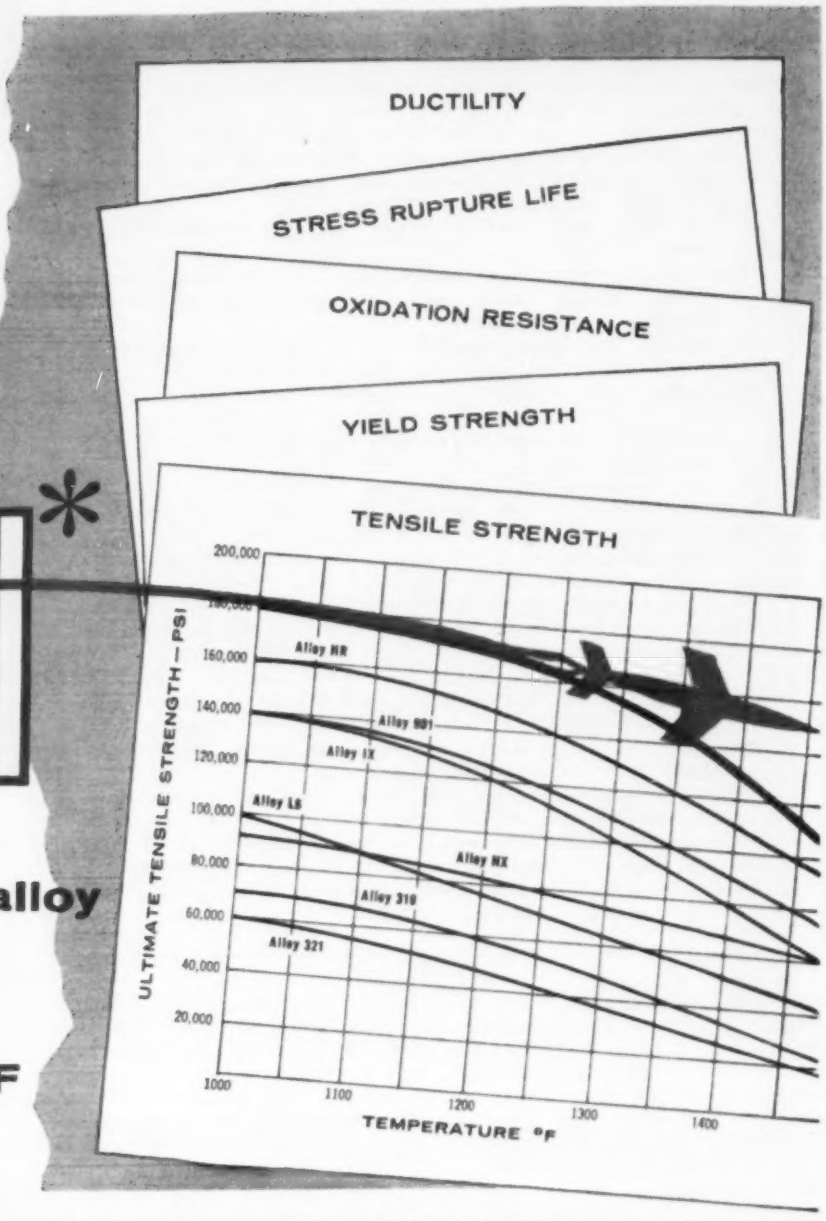

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can be accommodated physically as follows: pilot, along with controls and extendable optical viewing system can be located in the forward end of the capsule; passengers can be seated in the aft end of the capsule. Occupants can exit or enter through an airlock in the center of the 672-cu. ft. capsule. Occupants can be equipped with personal parachutes and in an emergency ejected along with lightweight seats through frangible patches in the capsule. Make-up oxygen can be recovered from the exhaust of the auxiliary power unit and the cabin atmosphere conditioned by filters, absorbers, and a water boiler system. Stored oxygen would be available if required. A self-sealing interliner for the capsule is under consideration.

• **Navigation/guidance**—Proposed guidance system would be inertial employing stable platform and digital computer. The system would compute and display to the pilot his position on a moving strip map of the earth or the stars. The pilot can determine his position visually with a viewing device and can superimpose this data on the strip map. By matching the two displays, he can locate his position and insert corrections into the computer thereby eliminating errors accumulated in the components and navigation system. Corrections supplied from ground-tracking data can also be inserted. For the rendezvous maneuver an optical tracking system which can provide range, azimuth and elevation data for the computer is being discussed. The computer then displays required maneuver for rendezvous. Provisions are incorporated in the navigation and guidance systems to accept automatic program sequences as commanded by ground data link, thereby permitting recovery of the pilot in the event of his incapacitation.

• **Controls**—Two control systems will consist of one using reaction control jets and inertial wheels driven by electric motors and another using conventional aerodynamic control surfaces. The former system will be employed in space operation while the latter is intended for atmospheric operations. The space attitude and control system which uses 12 reaction jets and three inertial wheels can orient the vehicle to any desired attitude, can maintain that attitude and then translate to another. Pure translation for maneuvering is employed in side and vertical axis. Simulation experiments indicate that the space control system is well suited to pilot control. A velocity type of control similar to those used in conventional aircraft is proposed. A manual emergency system bypassing all electronic equipment is used to provide acceleration type of control. Re-entry into the atmosphere presents the most difficult

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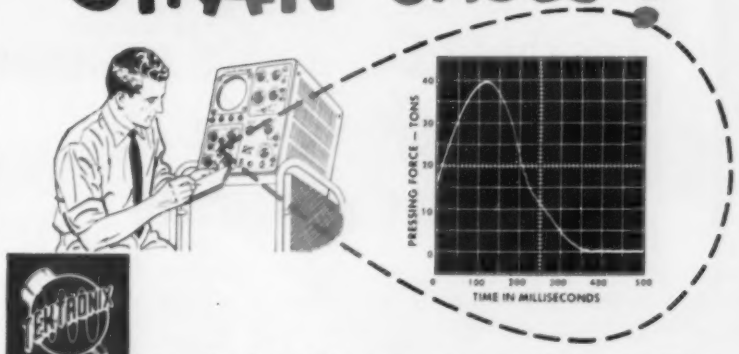

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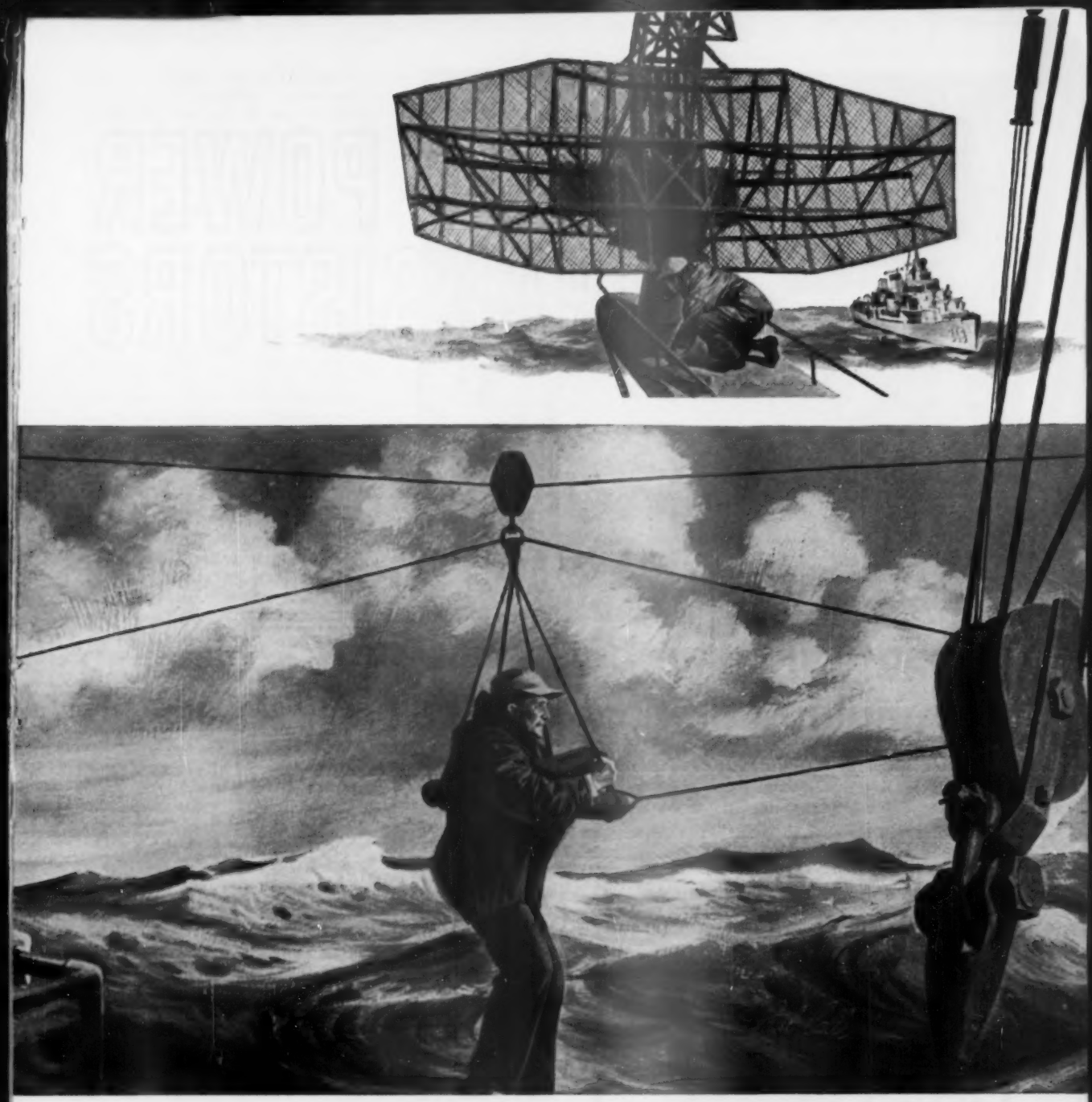

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• **Communications** – All communications needs probably can be satisfied by existing equipments. Where possible duplicate equipments will be included. The principal development effort will be devoted to an atmospheric re-entry communications system. Equipments to be included with vehicle will comprise voice communications, telemetry, tracking and command link during orbit, re-entry, descent and landing, communications between space station and space workers (where the vehicle is employed with space station).

Transit Tests Confirm Accuracy Predictions

Washington—Measurement made on experimental navigation satellites Transit 1B and 2A show positional errors of 0.3 to 0.6 naut. mi., confirming that an operational navigation satellite system can provide earlier predicted accuracies of one-half mile by 1962, perhaps as little as 0.1 naut. mi. later.

Results of Transit satellite experiments were reported here at the National Symposium on Space Electronics and Telemetry by William H. Guier of Applied Physics Laboratory (APL), Johns Hopkins University. The laboratory developed the Transit satellites under sponsorship of Navy and Advanced Research Projects Agency.

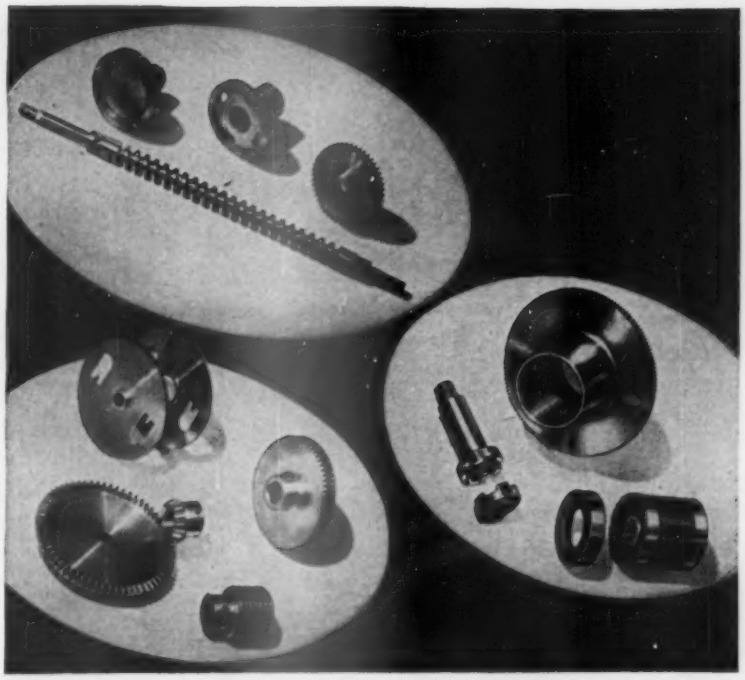
Transit 2A, launched June 21, is still transmitting, but Transit 1B, launched Apr. 13 (AW Apr. 18, p. 29), lost its radio voice on July 11 because of a failure in its power supply.

Guier cited several improvements which "will certainly guarantee meeting the one-half nautical mile accuracy requirement by 1962." These include:

• **Extension of the network** of ground tracking stations, presently limited largely to the U. S., Canada and England, to provide global coverage should greatly improve accuracy of determining satellite orbital parameters.

• **Accurate timing reference,** which must now be provided on a day-by-day basis to synchronize tracking stations, will be supplied by the satellite itself when the operational models become available.

Guier also said that APL has only recently reached the point where initial operational problems involved in the transit experiments are under sufficient control to start a serious search for consistent biasing error in the over-all system. An important aid in this search is the accurate optical sighting data provided by the Smithsonian Astrophysical Observatory, he added.



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Always-correct assemblies are assured with positive operating stops built into the swaging tool. The Resistoflex Field Swager, therefore, can be used with a minimum of training to produce finished lines with the same reliability as factory-assembled products.

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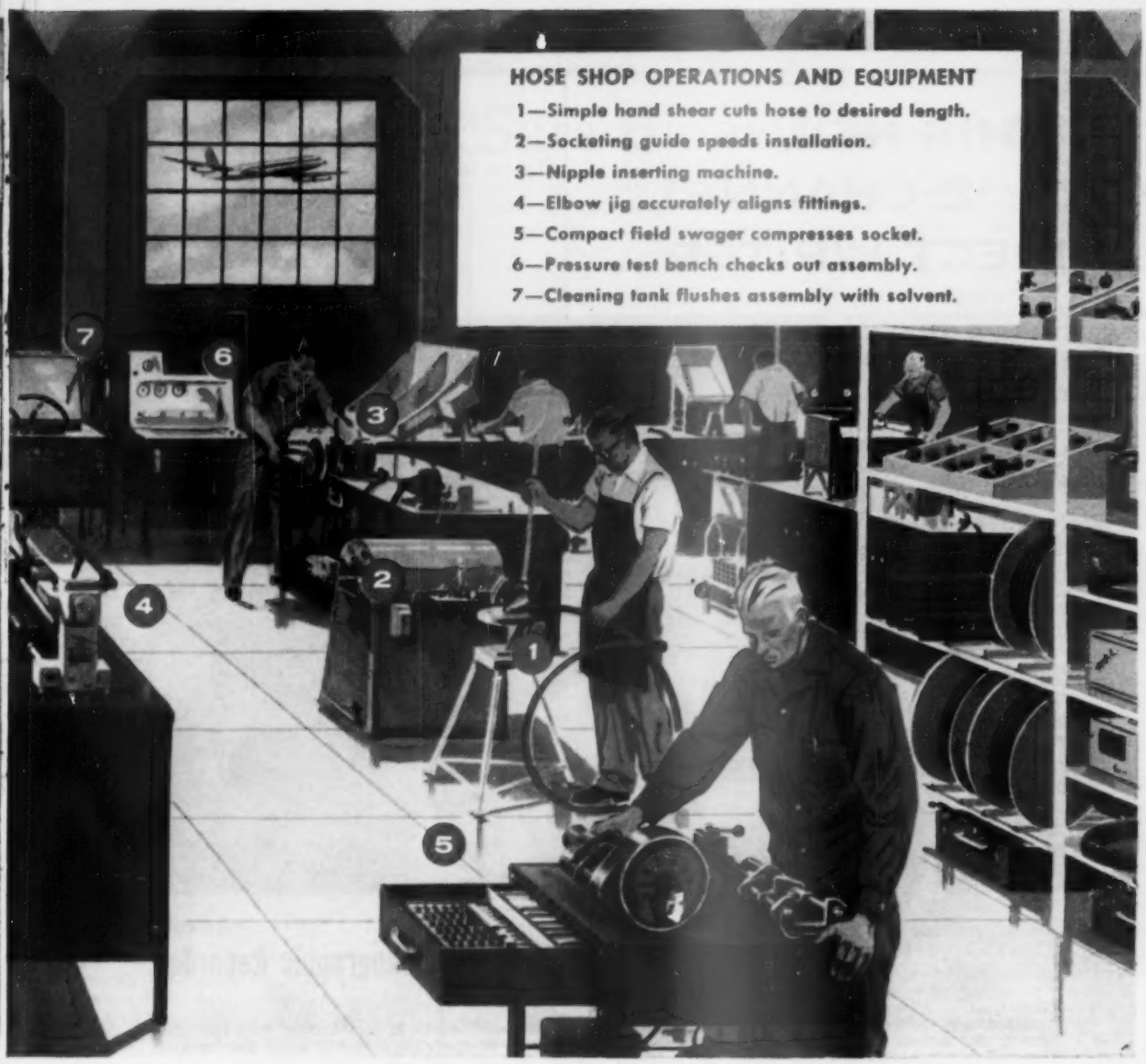

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More and more airline and commercial operations are investigating the advantages of Fluoroflex-T hose assemblies and the reliability and economies offered by the Resistoflex portable field tool.

Whenever overhaul, repair or maintenance problems are found in fuel, hydraulic, lubrication, water injection, oxygen or other special service lines, Fluoroflex-T assemblies with swaged fittings can usually provide a permanent "fix." To assure trouble-free operations, specify Fluoroflex-T for original equipment, retrofit and repair. Write for complete information today.

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* *mounts in 10½" of rack space or in a separate portable case*

* *interchangeable "850" Series plug-in preamplifiers for each channel*

SANBORN Model 297 Oscillographic Recorder

Compactness and versatility without loss in performance is the design concept for this new 2-Channel Direct-Writer from Sanborn. The Model 297 provides two *complete* recording channels in only 10½" of panel space, making it extremely useful as a monitoring recorder — integrated with large instrumentation setups in data processing installations, test stands and similar applications. In its own portable case, the Model 297 will be equally useful in *laboratories and field applications* as a bench-top instrument.

Preamplifiers are "850" Series plug-in interchangeable units, available in Carrier, DC Coupling, Phase Sensitive Demodulator, and Low Level types. They may be used in any combination, one for each channel. An internal MOPA for carrier and chopper excitation is also available.

The basic recorder assembly houses a preamplifier power supply, transistorized power-amplifier power supply, and two transistorized current-feedback power amplifiers with *built-in electrical limiters* that provide damping at all times. The entire unit has built-in forced filtered air cooling.

The recording mechanism has rugged, enclosed galvanometers with velocity feedback damping . . . 4 different chart speeds selected by push buttons . . . timer/marker stylus with 1 second timer . . . approximately 6 inches of visible chart with immediately visible traces made by heated stylus. The electrical and mechanical specifications in combination with the many "big system" operating features make the compact Model 297 one of the most useful, reliable 2-channel direct writers available.

Contact the Sanborn Sales-Engineering representative nearest you or write the main office in Waltham for complete information and application assistance. Sales-Engineering representatives are located in principal cities throughout the United States, Canada and foreign countries.

Model 297 2-Channel Recording System Specifications
(Less plug-in preamps)

Sensitivity: 0.1 volt/mm nominal
Frequency Response: DC to 125 cps within 3 db, 10 mm peak-to-peak amplitude
Gain Stability: Better than ½% from 20°C to 40°C or line voltage change from 103 to 127 volts
Linearity: Max. non-linearity is 0.2 mm
Electrical Limiting: Approximately ±115% of full scale
Chart Speeds: 1, 5, 20, and 100 mm/sec. by mechanical push button
Dimensions: 10½" high x 16" deep x 19" wide
Paper Take-up: electrically operated

(Specifications are subject to change without notice.)

SANBORN COMPANY
Industrial Division
175 Wyman Street Waltham 54, Massachusetts

USAF Meeting Stirs Bionics Interest

By Philip J. Klass

Dayton, Ohio—Nearly 700 persons with great diversity of scientific backgrounds, ranging from psychiatry to mathematics, from electronics to biology, from philosophy to bio-chemistry, turned out for the first symposium on bionics—the science of systems that are life-like in function.

Attendance at the symposium, sponsored by Wright Air Development Division, was more than double WADD's estimate when it scheduled the conference.

Objective of the symposium was to bring together both physical and biological scientists for mutual exposure to the other's problems, knowledge and techniques and to break down informational barriers that have separated them.

Air Research and Development Command's commander, Lt. Gen Bernard A. Schriever, told the group that Air Force hopes that bionics will provide clues both for improving its weapons and the performance of the men who operate them. "Bionics attracts our interest," Schriever said, "because the use of living models as a key to the functioning of electronic and mechanical systems unlocks a new area of technology."

Military Interest

Most of the technical reports presented here during the three-day symposium dealt with techniques, such as artificial neuron networks, self-learning and self-adapting machines, which are applicable to computers and automatic data processing—important areas of military interest.

However, WADD's chief scientist, John E. Keto, emphasized that the Air Force also is anxious to learn more about some of nature's ingenious techniques in creating microscopically small but extremely effective sensors.

Here are some of the examples cited by Dr. Harvey E. Savely, director of life sciences, Air Force Office of Scientific Research:

• **Pit-viper type snakes,** which include rattlesnakes and copperheads, have a tiny infrared sensor located between their nostril and eye which is so sensitive that it responds to a change in temperature of 0.001C.

• **One species of fish** found in tropical areas can detect a change in the electric field of the water around it which is as small as 0.003 microvolts per millimeter, corresponding to a current level through the fish of 0.00002 microamperes per square centimeter. This fish can discriminate between two covered glass rods whose diameters differ by only two millimeters.

• **Moth, upon which bats feed,** has developed a tiny hearing organ that is sensitive to the ultrasonic cries emitted by the bat, enabling the moth to take evasive action. "By far the best microphone for picking up bat cries," Dr. Savely said, "can be made by attaching electrodes to the nerve leading from this moth's ear."

Nature's Method

Physical scientists also can profit from a better understanding of nature's method for converting nerve impulses from a digital code into analog form for analysis and mixing, Dr. Savely pointed out. Another important area for investigation is nature's method of storing and retrieving information.

Such understanding does not imply direct imitation of nature's solution, Dr. Savely cautioned. He cited the airplane and bird flight as an example, noting that "a basic research program 60 years ago in the structure of bird feathers would have led us into a blind alley. We must look for the fundamental principles at work in the nervous system and not be tempted to imitate what may turn out to be the feathers."

The solution to some of these fundamental problems represents "our greatest intellectual challenge and will have the greatest practical significance for mankind," Dr. Savely predicted.

Program to simulate the operation of the brain is one of the highest priority research programs in the Soviet Union, Rand Corporation's Paul Armer told the conference here. During Armer's visit to Russia he was told that 500 physicists had transferred into the physiological sciences for an all-out attack on the problem.

Several symposium speakers here commented about the need for developing new mathematical techniques specifically suited for dealing with the "organized complexity" of living things. Most existing mathematics was developed to meet the needs of the physical sciences because, in the past, biological sciences were more historical than analytical in their nature.

The Russians have long been recognized for their advanced work in mathematics and Armer reported that many of the top Soviet mathematicians are now working in the field of computers and self-adapting systems (AW Sept. 19, p. 33).

Armer noted that the word cybernetics, coined by MIT's Dr. Norbert Wiener, has become almost a household word in Russia.

Data Processing

Representative of the wide scope of papers dealing with bionic techniques applicable to automatic data processing and self-learning/adapting systems, were the following:

• **Improved reliability** of digital computers through the use of a special type of redundancy which shows some resemblance to that of the neuron networks in the brain, was described by Dr. K. K. Maitra of Radio Corporation of America. Using modules in groups of three, called "triplets," especially designed for the particular logic function to be performed, the triplet can continue to function properly despite momentary failures of one of its three component modules. Relatively unreliable modules connected up in redundant triplet fashion can give considerably better over-all system reliability than using more reliable modules connected in conventional fashion. Use of higher-order tri-

A Doctor Comments On Bionics

"Neuro-physiological and behavioral studies have brought us to the brink of clearer vistas of the incredibly complex relationships between neural organization and behavioral correlates," Dr. W. R. Adey, Departments of Anatomy and Physiology, University of California at Los Angeles, said at a recent Space Electronics and Telemetry symposium. "We have reached a point where we must go hand in hand with our engineering and physicist colleagues if we are to progress further.

"For collaborative engineering efforts to be fruitful, we would respectfully ask that the engineer first learn his biology. . . . Many of the great biologists of this country [have] their library shelves well stocked with volumes on electronics and computing engineering. It would be the biologists' fondest hope that in joint studies the engineer would first learn his neurophysiology before attempting a model of the most complex of living organs."

(ADVERTISEMENT)

DATA AND CONTROL SYSTEMS

Young Company Surprises Industry and Competitors with Early Breakthroughs

Danbury, Conn.—A relatively young company, Data-Control Systems, Inc., has stolen the march on competitors with the production of the industry's first solid-state discriminator. In addition, the company has been in production for some time on a voltage-controlled oscillator, the AOV-3, which has been described as the "best in the industry", and a low level, smaller airborne oscillator, the AOV-10, which likewise appears to surpass anything currently on the market. Moreover, the company has just announced a new high impedance version of its electronic commutator, to meet the industry's coming requirements.

• **Data-Control Systems** was formed on October 1, 1957, just a few days before the announcement of Russia's Sputnik I. Since that auspicious day, the four original founders, including Dr. Robert J. Jeffries, a former president of the Instrument Society of America, have built an organization that today employs some 275 people. The Company's Research and Engineering Department, under the direction of Mr. Raymond A. Runyan, totals approximately fifty persons, and includes many of the country's outstanding designers of electronic data systems and measuring instruments.

Proprietary products include complete FM/FM telemetry airborne and ground systems including fixed and switchable subcarrier discriminators, reference oscillators, mixers, tape speed compensators, amplifiers, voltage-controlled oscillators, strain-gage oscillators, electronic commutators, calibrators, automatic standardization systems, sensing devices, data display devices and remote control links employing radio and wire transmission.

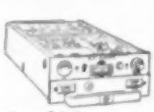
• **Several complete** ground-based data-acquisition systems designed and built by the young firm for the Boeing Airplane Company, Seattle, have just been delivered, and will be used for the R&D flight-test program of the "Minuteman" ICBM. Other customers of DCS include Aerojet-General, Arma, Chrysler, JPL, Lockheed, Douglas, North American Aviation, and Martin, as well as numerous military installations and university research centers.

• **The new solid state** FM/FM discriminator, Model GFD-3, exhibited at National Symposium on Space Electronics and Telemetry in Washington, D. C., is a logical outgrowth of the research in this field that DCS has pioneered from its very inception. For detailed information as to specifications, prices, etc., contact DCS directly: Dept. AW-10, East Liberty Street, Danbury, Conn.

DATA-CONTROL SYSTEMS INC. President, Robert J. Jeffries (left) checks installation of company's new transistorized subcarrier discriminator in Minuteman telemetry ground station just prior to shipment, while R. A. Runyan, V. P. of Research (right) and R. H. Hyde, Manager of Marketing, look on.

FOUR DCS PRODUCTS TERMED "WORLD'S FINEST"

Dr. Robert J. Jeffries, President of DCS, describes his company's latest breakthroughs in these words: "We honestly believe that the Discriminator, Oscillators and High Impedance Commutator just announced represent the finest instruments of the type available today, from both manufacturing and state-of-the-art standpoints. We are proud to add them to our growing list of standard products which are bringing new standards of performance to research instrumentation systems."



GFD-3: Solid state compact phase lock loop discriminator; low power consumption, high power out; highly linear; ultra stable; extreme reliability.

APC-2: Solid state electronic commutator; high input impedance; low noise and cross talk. Unique modular construction permits wide range of switch points and sampling rates.

AOV-3: Solid state miniature voltage-controlled oscillator; long term stability; max. linearity; low distortion over wide temperature range.

AOV-10: Millivolt solid state miniature voltage-controlled oscillator combines best performance of DC amplifier and VCO into simple economical plug-in switch for strain gages, thermocouples, etc. Ultra-stable over wide temp. range.

Telemetry Helmet

Telemetry built into flight helmet can be used to amplify and transmit pilot physiological reactions, such as heartbeat, respiration and brain-waves. Microminiature telemetry equipment, small enough to fit into helmet, can accept signals as small as 25 microvolts. Up to nine channels can be provided inside the helmet. Equipment, developed by Vector Mfg. Co., Southampton, Pa., was shown at recent Space Electronics and Telemetry Symposium.

plates increases system reliability for the first few stages, but then reliability falls off as system complexity increases, Maitra said.

• **Use of multi-level logic elements** instead of binary (two-level) elements may open the way to 1,000:1 improvement in computer reliability, symposium heard from Jack Cowan, Massachusetts Institute of Technology's Electronics Laboratory. Cowan is one of a group of young scientists of diverse backgrounds working in MIT's electronics laboratory under the direction of Dr. Warren S. McCulloch, a psychiatrist who gave up his practice some years ago for basic study of the brain and how it operates.

• **Electro-optical matrix,** which exhibits some of the capabilities of the eye in its ability to recognize contrast, convexity, moving edges and dimming, was described by Dr. E. E. Loebner of RCA's Research Laboratory. The electro-optical matrix consists of a series of solid-state light amplifier panels constructed from photoconductors and electro-luminescent elements with optical coupling and feedback between neighboring cells. These electro-optical matrices appear ideally suited for use as image input devices for digital computers, eliminating the need for using computer itself to extract topographical features. Removing this function from the computer and performing it in an electro-optical matrix follows in the footsteps of nature, Dr. Loebner pointed out. From a genetic and embryological viewpoint, the retina of the eye represents a part of the brain which has peeled itself off and become a highly organized separate input device, Dr. Loebner said. The present state of RCA's work in the electro-optical matrix has reached the point where company's scientists have constructed a functional equivalent of the retina of a frog, Dr. Loebner said.

The frog's eye figured in a number of the reports presented here. A group of MIT scientists recently reported the results of experiments which appear to give vastly better insight into the operation of the frog's eye and its relationship to its brain. This may prove a jumping off place for increased insight into the functioning of the eye and brain of more complex forms of life.

Sparked by the MIT findings, Bell Telephone Laboratories has constructed an electronic analog of the frog's eye using artificial neurons, called "neuromimes," Dr. W. A. van Bergeijk reported. Dr. van Bergeijk, a zoologist, is working with an electronic engineer, L. D. Harman, report co-author, who developed the neuromime. It employs five transistors, two capacitors, two diodes and about 18 resistors and functions as a one-shot multivibrator. There are five inputs, any one of which can trigger it, and one inhibitory input. Using seven neuromimes, BTL scientists were able to construct a simple configuration which demonstrated certain of the characteristics of the frog's eye and brain. Dr. van Bergeijk speculated that the use of such artificial neurons would permit scientists to construct biological mockups or models. The time may come, he said, when models will be sufficiently realistic to permit them to predict biological reactions and responses in living things not yet known.

Speech Recognition

Logic circuitry which can "understand" and discriminate between spoken words, was demonstrated by W. C. Dersch of International Business Machines Corp. The IBM investigation is aimed at determining whether circuitry and techniques can be developed which will, in effect, understand at least certain basic words spoken by humans.

As a starter, IBM has attempted automatic recognition of spoken numerals, from zero to nine, by analyzing the sound of each numeral. With speakers who enunciate clearly, logic circuits developed to date can correctly identify 99 out of 100 numerals spoken into a microphone. With speakers who speak less distinctly, the circuit is able to score about 95% correct. The tests were run with ordinary room noise in the background.

IBM analyzed the phonetic construction of each of the 10 numerals, found that they consisted of one, two or three characteristic sounds which could be consistently identified in a variety of different voices and pronunciations. Voiced sounds, produced by the vocal

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chords, roughly equivalent to vowels and frictional sounds, roughly equivalent to consonants, which are found in two forms: weak and strong.

To enable the automatic voice decoder to discriminate between voiced and frictional sounds, IBM passes them through a phase shifter, then examines the envelope of the voice modulation. Voiced sounds always produce an asymmetrical envelope whereas frictional sounds are symmetrical. Machine discriminates between weak and strong frictional sounds on the basis of their energy level, Dersch said.

Spoken Numeral

By analyzing each spoken numeral, determining the presence or absence of voiced, strong and/or weak frictional sounds and their sequence in the word, the machine is able to discriminate between them and in effect understand 10 different words. In its tests, IBM has introduced random noise at 10 times the normally anticipated background level without adversely affecting recognition performance, Dersch said.

The question of whether machines exhibit the qualities of human intelligence, i.e. can "think," has stirred up as hot a debate in Russia as here, according to Rand Corporation's Armer.

One viewpoint is that a digital computer is not a "giant brain, only a phenomenally fast and accurate moron," Armer said. But he does not feel there is any sharp line of demarcation or any single criteria which can be used to determine whether a machine does or does not exhibit human-like intelligence. Rather he sees men and computing machines in a continuous spectrum of intelligence in which at the moment man is far more advanced, but not necessarily destined to always remain so.

The sequence of operations that a digital computer follows in solving a problem is determined by its program, prepared by humans in accordance with certain procedures developed especially for computers and tailored to their design peculiarities.

More recently, researchers have turned their attention to programs for which the computer tackles a problem as a human being would, rather than in more conventional computer fashion. This approach is called "heuristic programing."

One of the earliest attempts at heuristic programing was based on detailed observations of how humans go about solving problems in sentential calculus after which the computer program was designed to imitate the human procedure, Walter R. Reitman told the symposium. Reitman is a psychologist at the Carnegie Institute of Technology.

Using this heuristic program, a com-

TI IN MILITARY ELECTRONIC SYSTEMS

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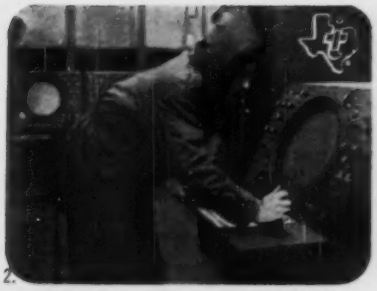
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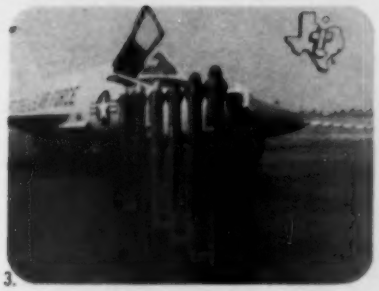
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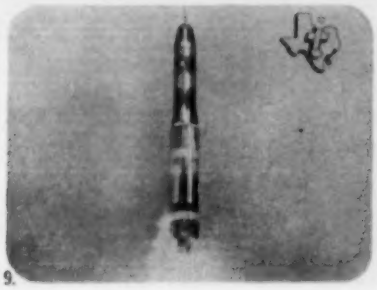
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A partial listing of equipment, designed, developed and manufactured by TI now operational in the Armed Forces includes:

1. AN/ASQ-8 magnetic anomaly detector, AN/AIC-15 intercom and TD-239A intervalometer for the U. S. Navy P2V ASW aircraft, built by Lockheed.

2. TARmac ASR-4 Airport Surveillance Radar for the Federal Aviation Agency.

3. Infrared optics for the U.S.A.F. FALCON Air-to-Air Missile, built by Hughes.

4. Anti-personnel Mine Detector AN/PRS-3 (XR-12) for the Corps of Engineers.

5. AN/APS-38A surface search radar, AN/ASQ-8 magnetic anomaly detector for the U. S. Navy S2F-1 ASW aircraft, built by Grumman.

6. Telemetry and guidance subsystems for the U. S. Navy CORVUS Air-to-Surface Missile, designed and produced by Temco.

7. AN/AQS-4 and AN/AQS-5 dipping sonar for the U. S. Navy HSS-1N ASW helicopter, built by Sikorsky.

8. AN/APS-80 surface search radar, AN/APA-125A radar indicator, AN/ASQ-8 magnetic anomaly detector and TD-239A intervalometer for the U. S. Navy P5M-2 ASW patrol seaplane, produced by Martin.

9. Programmers for the U.S.A.F. TITAN Intercontinental Ballistic Missile, built by Martin.

10. Surveillance sensors for the U. S. Army Signal Corps SWALLOW AN/USD-4 Combat Reconnaissance Drone, produced by Republic Aviation.

11. Surveillance sensors for the U. S. Army Signal Corps AN/USD-5 Combat Reconnaissance Drone, produced by Fairchild.

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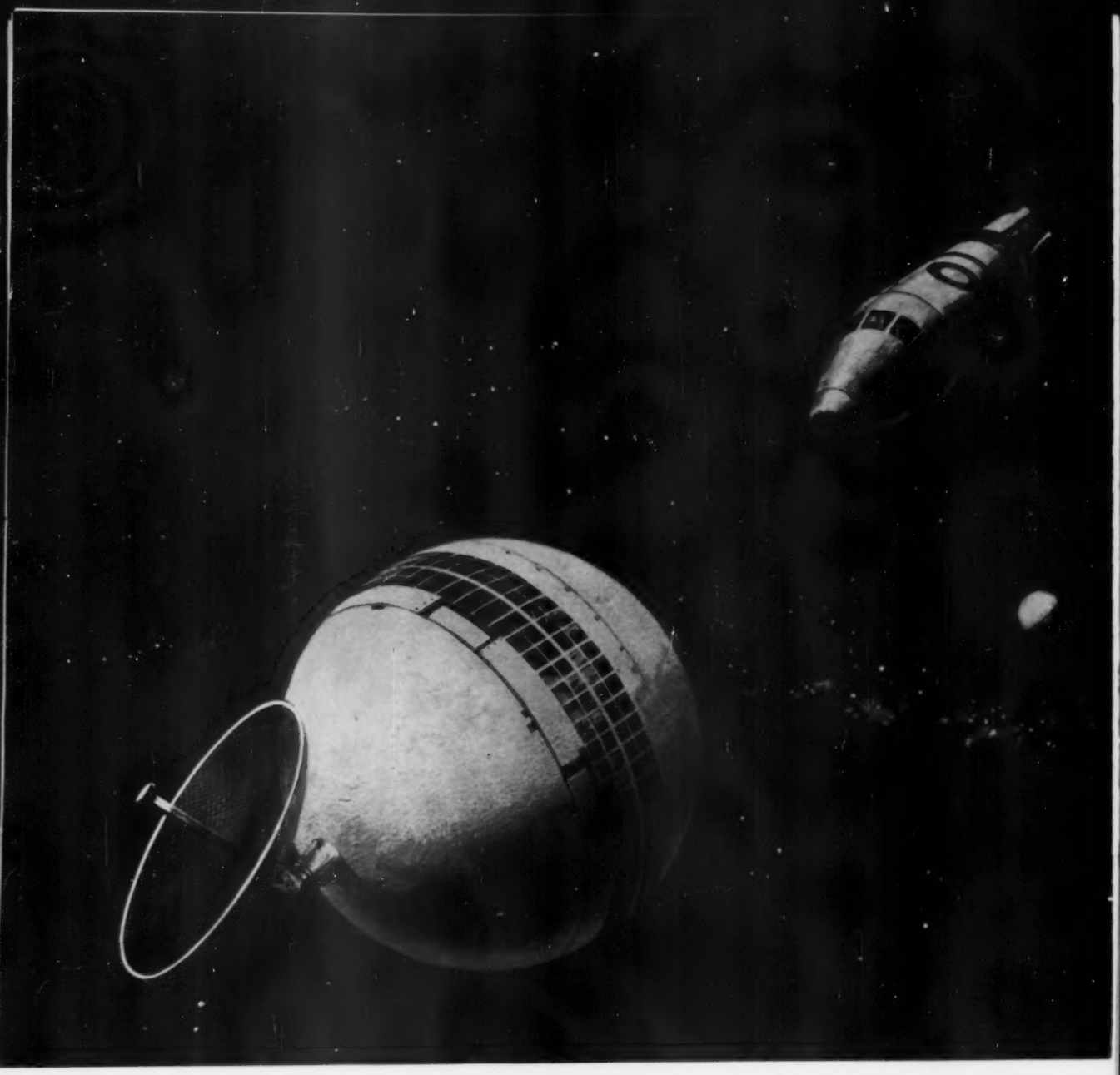

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puter succeeded in proving 38 of 52 theorems it was given, and in one case actually produced a more elegant proof than had been available previously, Reitman reported.

Heuristic programing also has been applied to running a production line and allocating jobs to individual workers to achieve a balanced line. One scientist currently is working on a heuristic program which will simulate the behavior of a trust fund adviser in selecting stocks, according to Reitman.

General Programs

More recent efforts have been devoted to developing more general heuristic programs which are applicable to a wider range of types of problems. Using such a general-problem-solver (GPS) series of programs, scientists have demonstrated its ability to solve the well-known "missionaries and cannibals" problem of getting the three missionaries over a river in a two-man canoe without loss of any missionaries.

One of the problems of heuristic programing is to develop criteria for measuring how closely the program simulates the behavior of a human being, Reitman said.

Another problem results from the fact that general-problem-solver routines may require 15,000 to 20,000 words which consumes much of the storage capacity available in existing computers. However, this problem should be eased with the advent of larger computers more suited to nonnumeric processing, Reitman said.

A quick count of hands in the closing minutes of the bionics conference indicated the following audience breakdown by scientific discipline:

- 60% Engineers.
- 10% Physicists.
- 10% Mathematicians.
- 5% Psychologists and psychiatrists.
- 5% Biologists and bio-physicists.
- 10% Miscellaneous.

Wright Air Development Division will publish proceedings of the bionics symposium, expected to be available in about 30-60 days. Copies can be obtained by writing WADD, Attention: Col. A. L. Wallace, Jr., Advanced Systems Technology, Symbol: WWR.

Martin's Electronics Division Moves Into Non-Defense Work

Martin-Baltimore Electronics Division is aiming at an increased share of the industrial market to achieve its goal of $100 million total sales—about double this year's level—by 1965.

The division is shooting for a further doubling of sales by 1970 as a result of planned expansion into non-defense lines.

Current workload is predominantly defense contracts, with the division acting as prime contractor for only about 10% of them. Part of the 1965 goal is to make the split about 50-50 between the role of prime and subcontractor. Martin expects that defense contracts will continue to dominate the workload.

Division Organization

Electronics Division was organized last January with John J. Slattery as manager. Purpose was to consolidate the company's electronics work that was not a major part of a contract already in another division. For example, the extensive avionics work on the Titan intercontinental ballistic missile continues to be handled by Martin-Denver. But work on infrared guidance and antisubmarine warfare system not tied to specific work in other divisions comes under electronics.

Martin has been making a gradual transition from an airframe to an avionics company over the last five years, and currently about 40% of over-all engineering strength is in one phase or another of electronics. Martin-Denver strength is about 37% in the field, Orlando accounts for 45% and the Baltimore operation, which includes Electronics Division, contributes about 43%.

Major Target

One major target of Electronics Division's future work is in the field of machine-tool control. Engineers are now working on date-processing research aimed at increasing versatility of machines so that low-quantity production runs can be handled economically with automatic control. One possibility is to use a single data processor to feed information on different tasks to a series of groups of machines in sequence.

Another area under study is the possibility of using code techniques to replace engineering drawings, where the subjects of the drawings are standardized components used on more than one assembly. Slattery believes a large number of routine engineering drawing instructions can be eliminated by punch-card or tape techniques.

Baltimore Electronics Division employs about 2,900 persons currently, with about 900 on engineering work. Plant space totals about 300,000 sq. ft. converted from former aircraft component work areas to an electronics environment, dust-free, light and climate-controlled where necessary. The company spent about $1 million dollars to make the conversion from the block-floor, open-factory environment characteristics of aircraft plants, and thus got its "new" avionics facility for about $3 per square foot instead of the customary $20 per square foot for new construction.

FILTER CENTER

▶**Esoteric Molecular Devices**—Wright Air Development Division is sponsoring a series of three studies aimed at producing advanced molecular avionic devices. One study in progress under a $100,000 contract at Hughes Semiconductor Products is for a molecular bandpass amplifier utilizing an inductance diode. Amplifier should be tunable by tuning of diode and is expected to operate in the lower RF range. A second contract, awarded to Radio Corp. of America, is for a molecular tunable filter. The third study is being handled by Electro-Optical Systems, Inc., and is for a tunable, molecular amplifier (AW June 6, p. 99).

▶**Instrumenting Man for Space**—Example of how lightweight, sensitive semiconductor strain gage (AW Feb. 1, p. 74) could assist in monitoring man's reaction in space was demonstrated recently at Electro-Optical Systems, Inc. Pasted on a man's arm, the small strain gage provided pen chart recording of human pulse rate. Output was ¼ millivolt, deflection 1.6 microinch. Firm will start medical electronics program shortly to combine microminiaturization and bio-medical techniques for man in space.

▶**New Semiconductor Firm Organizing**—New company which will specialize in research, development and production of micro semiconductor components and systems and molecular circuitry is being formed in Los Angeles, Calif., by two scientists formerly associated with Pacific Semiconductors, Inc., and a former sales manager with General Instrument Corp. The three principals are Thomas C. Hall, until recently surface research program director at Pacific; Arthur Feldon, former reliability manager with Pacific, and Steve Manning, previously regional sales manager with General Instruments. The firm, for which a name has not yet been selected, will employ new approaches to micro packages involving philosophy of surface passivation in an effort to cut size and cost and boost reliability of these small components, according to Hall. Different surface passivation

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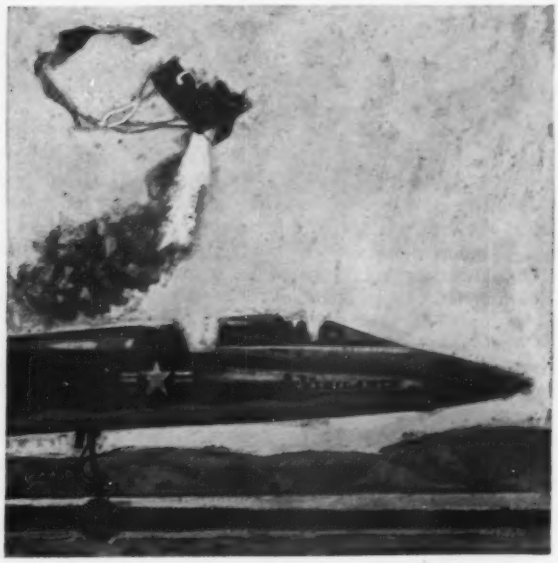

GROUND LEVEL ESCAPE. The first successful rocket-catapulted ground-level escape system was developed by Columbus. In case of emergency it is equally effective on the ground or in the air... at landing or jet speeds.

RESEARCH AND DEVELOPMENT. Cryogenics research at Columbus led to the development of liquid oxygen systems for aircraft. Now one cubic-foot of LOX can replace 862 cubic feet of gaseous oxygen.

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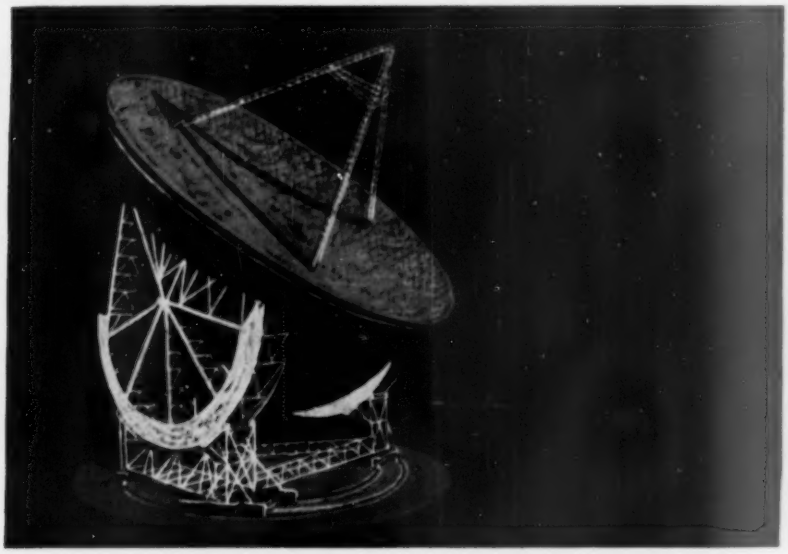
NEW TARGET MISSILE. Two missiles in one, this unique target missile can carry out either high or low level missions equally well. It performs from subsonic through Mach 2 speeds, and from ground level to 60,000 feet. Under development for the Army by the Columbus Division, it is rocket launched, ramjet powered.



THE BIG "EAR." The world's largest radio telescope reflector, 600 feet in diameter and more than seven acres in area, is being built by the Columbus Division for the U.S. Naval Radio Research Station in Sugar Grove, West Virginia. The 10-foot thick movable reflector will have a potential range of billions of light years.

methods from those which have made Pacific components successful will be developed, Hall says. A report by Hall on surface passivation of microcomponents, originally scheduled for presentation at recent Wescon, was withdrawn at the last moment by request of Pacific Semiconductors.

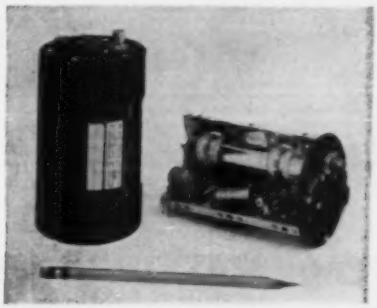
► **Signed on the Dotted Line**—Major contract awards recently announced by avionics manufacturers include:

• **Packard Bell Electronics,** $3 million prime contract from Navy Bureau of Weapons for production of the AN/ASQ-19, an integrated avionics system which combines communications, Tacan navigation and identification.

• **Aeronutronic Division,** Ford Motor Co., $97,543 contract from Wright Air Development Division, for research on feasibility of high-speed, real-time automatic recognition of pulse emitter signals. Contract details are classified.

NEW AVIONIC PRODUCTS

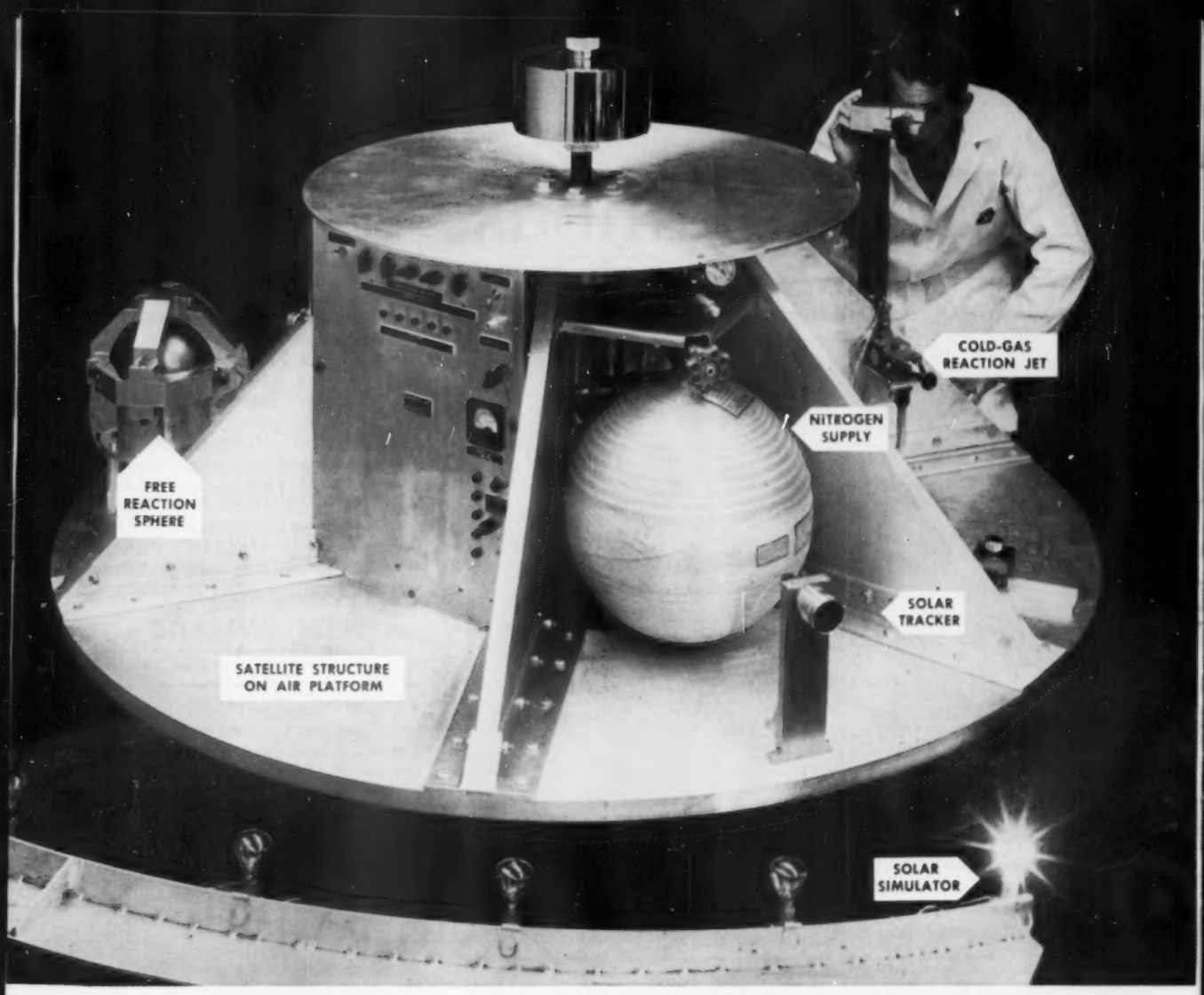
• **L-band transmitter,** Model 2701, suitable for use as a beacon on target missile, is available in airborne or ground use packages. Frequency range is 1,650 to 1,680 mc., FM modulated with 800 milliwatts minimum power out. Trans-



mitter operates from 0.7 amp. at 29 v. input over −55 to 72C range. Integral power supply is included. Dimensions are 5¼ in. length, 3⅞ in. in diameter. R. S. Electronics Corp., 435 Portage Ave., Palo Alto, Calif.

• **Subminiature subcarrier** transistorized oscillator, Model TOE-300, 1¼ cu. in., constitutes several orders of magnitude reduction in size over the company's earlier models. Unit is said to be able to withstand severe environmental conditions. Bendix-Pacific Division, Bendix Corp., 11600 Sherman Way, North Hollywood, Calif.

• **Miniature Accelerometer,** Model 609, weighs 6 oz., measures 1.5 in. x 1 in. x 1 in. not including mounting base and electrical connector. Dynamic Error Band, a figure which is a function of linearity, hystersis, resolution and re-



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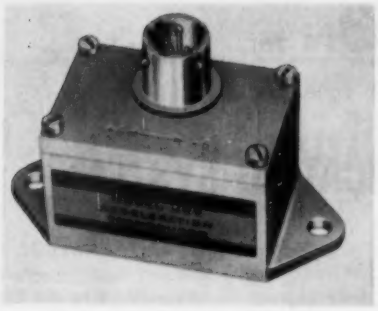
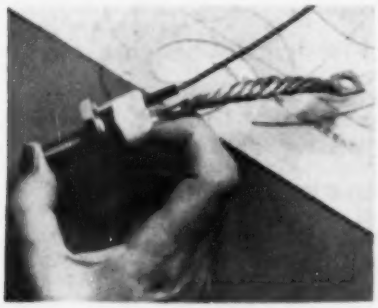


peatability, is as low as ±1%. Specifications on this model include: resistances –1,000 to 10,000 ohms; nominal resolution–as low as 0.25%; power rating –0.5 watt at 165F; damping–0.5 to 0.8 of critical over temperature range of –65F to 165F; cross axis acceleration error–0.01g/g max. Bourns, Inc., Instrument Div., 6135 Magnolia Ave., Riverside, Calif.

• **D.C. magnetic amplifiers** with output linear range of ±7.5 v. into load resistance of 1 kilohm and higher. Units are push-pull amplifiers which will provide outputs for input signals in millivolt range. Operation over –55 to 85C range is possible. Bulletin M-24, containing all specifications, is available from the manufacturer, Airpax Electronics, Inc., Seminole Division, Fort Lauderdale, Fla.

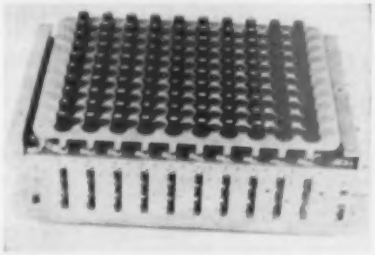
• **High-current silicon transistors,** available in three series with collector current ratings of 10, 15 and 30 amp. and current gain of 10, have junction operating temperature range of –65C to 150C. Devices have low saturation re-



sistance, with typical value of 0.15 ohm at 25C. Transistor is housed in double-ended hermetically sealed ceramic case. Collector is electrically and thermally connected to mounting study. Manufacturer: Westinghouse Electric Corp., Box 2278, Pittsburgh, Pa.

• **Adjustable drop-out relay,** Type RSH-3D and -6D, providing up to 50% adjustment of drop-out-to-pull-in ratio before hermetically sealing the relay. Relays are available in SPDT models with average sensitivity of 22 mw., or DBDT with sensitivity of 40 mw. Standard contact rating is 2 amp. at 28 vdc. or 1 amp at 115 vac. Relay measures ¾ in. in diameter, slightly over 2 in. long. Weight is 2 oz. Ambient temperature operating range is –65C to 125C. Manufacturer: Allied Control Co., 2 East End Ave., New York 21, N. Y.

• **Logic circuit plug-in units,** Series 2010, for constructing high-speed digital computer or data processing systems for operation at data rates up to 5 mc. Plug-in circuits, fully transistorized, are available in seven functions including flip-flop, transistor gate, one-shot multivibrator, diode gate, clock pulse generator and level amplifier. Manufacturer: Rese Engineering, Inc., 731 Arch St., Philadelphia 6, Pa.



• **Pushbutton crossbar switch** performs function of large matrix of individual switches and patch-boards. Device has constant characteristic impedance of 75 ohms. Contact noise is less than five microvolts and thermoelectric noise is less than 0.01 microvolt/deg. C, permitting use with low-level thermocouple and strain gage signals. Contact resistance is 10-20 milliohms. Standard models are available with 10 x 10 six-pole switches and 20 x 10 six-pole switches. Manufacturer: James Cunningham, Son. & Co., Inc., P. O. Box 516, Zone 2, Rochester, N. Y.

• **Micro-miniature trimmer pot,** Model 80, single-turn unit measuring ¼ in. in diameter and weighing 1 gr., is designed with axial leads for use with printed circuit boards. Unit is available with resistances of 50 to 10,000 ohms, with 5% tolerance, one-watt dissipation. Potentiometer is contained in sealed JBDEC TO-9 transistor housing. Manufacturer: Spectrol Electronics Corp., 1704 South Del Mar Ave., San Gabriel, Calif.

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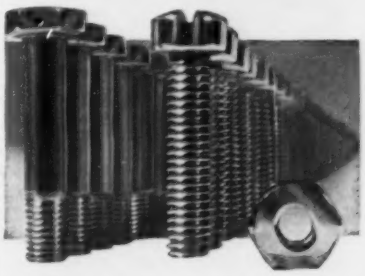

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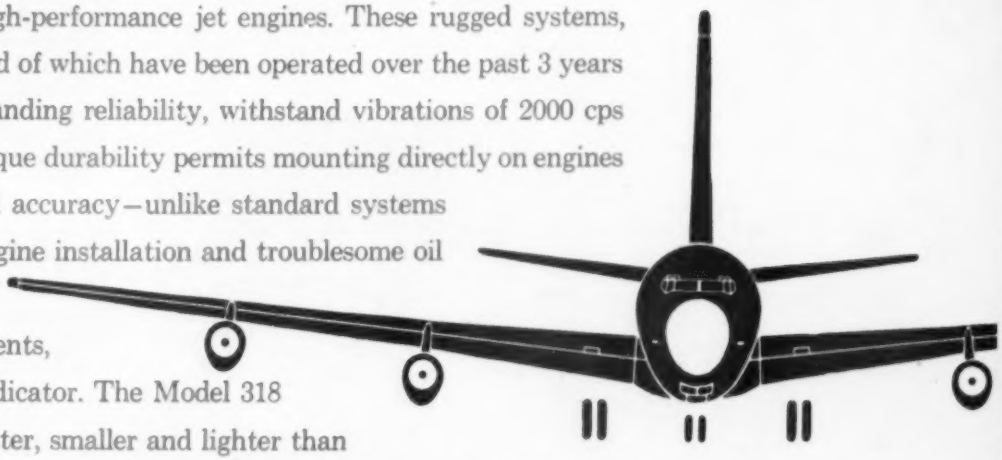

Standard hermetically sealed indicator, available in 1½" and 2". Model 296, a 2" indicator, is integrally lighted: in daylight, numerals and pointer are white and at night red. When power is off, pointer will move off-scale below zero.

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McGRAW EDISON

Celanese Bids for Major Missile Market

By Michael Yaffee

Asheville, N. C.—New United States ownership and financial backing by the 12th largest American chemical company is giving a rocket plant located here at the base of the Blue Ridge Mountains a second opportunity to break into the U. S. missile market. The plant is now called Amcel Propulsion Inc., a subsidiary of Celanese Corp. of America.

Initially, Amcel will concentrate on the development of rocket propellants, in particular solids with specific impulses above 280 seconds, propulsion units and explosives. The company also plans to develop and produce related items such as igniters, fuzes and safing and arming devices. Later the company may expand its efforts to include development and production of complete, small tactical weapons. Amcel has first right of refusal on Oerlikon's Mosquito anti-tank missile.

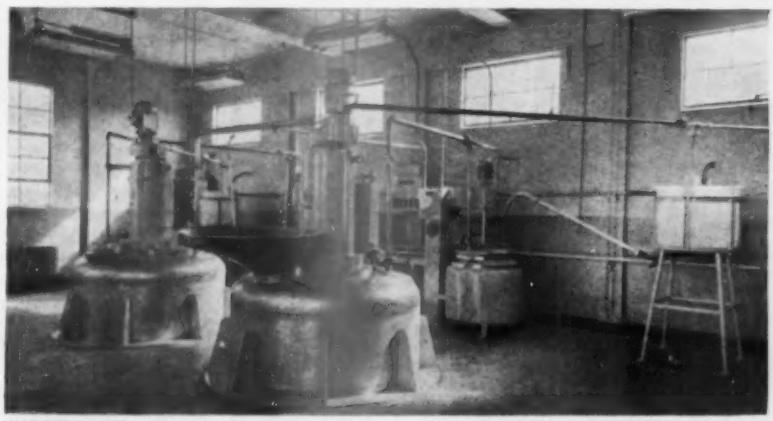
Basically, Celanese, through its Amcel operation, wants to become a significant factor in the missile field, particularly in propellants and explosives. There is no reason, one Amcel official declared, why this facility shouldn't be able to sustain itself at a minimum business of $30-$40 million annually in the foreseeable future. The only shadow on this prospectus is that Amcel has to show results by January 1, 1963 or face reorganization or curtailment of its operations.

The Asheville plant was originally established by Oerlikon Tool and Arms Corp. of America, an offshoot of the Oerlikon Machine Tool Works of Zurich, Switzerland, about nine years ago. It was designed primarily as a production plant for pressed charge, double base propellants and small (5 cm. and 8 cm.) air-to-air and air-to-ground rockets. The plant went into production briefly—"just about enough for a shakedown"—and then into mothballs. Reluctance of the military to deal with a missile company having foreign affiliations is generally given as the reason for the firm's failure to crack the U. S. military market.

Celanese Corp. of America, which had been looking for an entree into the missile business, bought Amcel in September, 1959. Celanese, a large textile and chemical firm with net sales of approximately $265 million in 1959, produces many chemicals basic to the manufacture of several different propellants,

AMCEL administration building at Asheville plant houses offices of technical directors. Road at machine shop (rear) leads to propellant processing area, static test cells and firing range.

MACHINE shop is equipped to produce a variety of metal components as well as special machines and equipment needed by other departments.



PROPELLANT mixing tanks are designed for processing double base propellants. Amcel is now installing equipment for the processing of composite propellants.

Radar Signal Simulators now in full production at Marquardt's Pomona Division will soon be in place at major USAF bases in the continental United States. Designated as the AN/GPS-T-4, the training system eliminates costly "real" flight operations and provides highly accurate flight plan simulation of as many as a dozen targets. Plug-in modules control flight characteristics and fuel consumption of the aircraft under simulation – assuring accurate computations. The system has many current and potential applications:

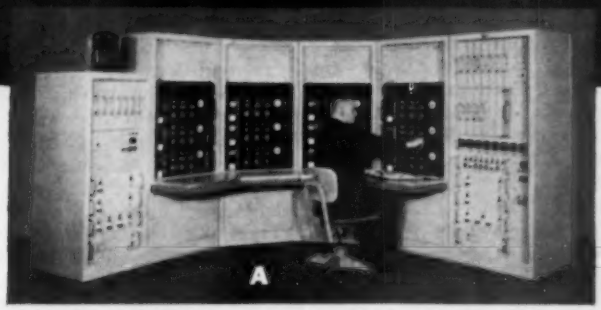
The T-4 is now in use in classroom operation for radar controlled interceptor simulation training by the USAF. Pilot simulators (A) operate target generators and trainees (B) man their usual stations and operate radar indicators as they would under tactical situations, while an umpire (C) controls the problem. Modular plug-in controls deliver completely realistic information of the particular aircraft's flight, range, and fuel capabilities. The T-4 system cuts both training time and costs to a fraction of normal operating methods.

Simulation of every type of missile mission is only one of a variety of potential military applications of the T-4 program. This aspect of training reduces costs and operational hazards as no other method can.

Airport traffic control training is simple and realistic with the T-4 concept. Modular plug-in operational characteristics of conventional passenger aircraft can simulate approach, landing, and take-off patterns and the system can be modified to accommodate as dense traffic conditions as desired.

Broad capabilities in radar simulation and training have been developed by the Pomona Division of Marquardt and even wider concepts are now in design stage. Detailed information on these and many other applications are available by writing Dr. Wendell B. Sell, Vice President-General Manager, The Marquardt Corporation, 2709 North Garey Avenue, Pomona, California.

Engineers and scientists experienced in these or related fields will find it rewarding to discuss their career futures with Marquardt. Founded in 1944, Marquardt today employs 4000 – of whom one-third are professional people. The company's growth is a parallel to the atmosphere of challenge and rewarding accomplishment that has existed since the firm's beginning.



FOUR TARGET generator cabinets, each housing three target generators, form the heart of the T-4 Trainer. One man operates six targets.

PLUG-IN MODULES accurately simulate flight characteristics and fuel consumption of the F-89, F-100, F-101, F-102, F-104 and F-106.

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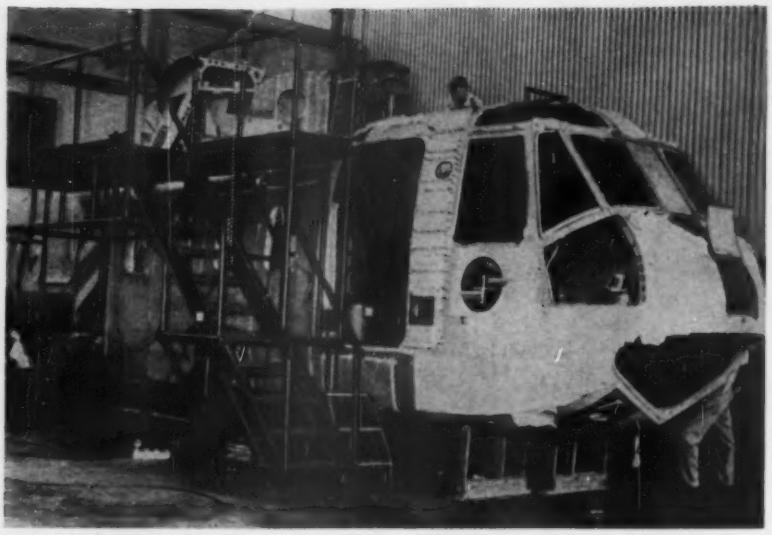


First Commercial S-61L Under Construction

Sikorsky S-61L commercial helicopter is shown under construction at Stratford, Conn. plant. The twin-turbine, 28-passenger aircraft is one of five on order for Los Angeles Airways with first delivery scheduled next year. Chicago Helicopter Airways has ordered six. First flight and start of certification tests of the S-61L is expected by end of 1960. The three-quarter front view above shows passenger doors and most of seven passenger windows on right side of fuselage. Compartment in lower front end of the helicopter is for housing of communications equipment. Baggage is carried in a sliding drawer under the floor on left side of fuselage, and in a bin near right rear of the fuselage. Bin is accessible from outside the fuselage, and the bin's cover forms a bench seat for three passengers. The S-61L has a boat hull for amphibious operation.

explosives and plastics and had been seeking means for further diversification. After examining several operations, Celanese decided that the Oerlikon plant in Asheville suited its requirements best. However, another group had an option on the plant. In order to acquire the plant, it is reported, Celanese exchanged 20% of its ownership in Amcel for the option. While Celanese refuses to identify the minority stockholder group, it is believed that this group is represented by Thomas Wheeler, who is chairman of the Amcel board of directores and not a Celanese man.

Price paid for Amcel by Celanese has never been disclosed. It is estimated that Oerlikon spent $7.5 million in the building and equipping of the plant. On its Bidder's Mailing List application for the government, Celanese listed the net worth of the facility as $4,635,955 as of Aug. 31, 1959. Since then, Celanese has put another $200,000 or so into the facility for construction of a research laboratory and for modifications of the manufacturing and administrative buildings.

Amcel Facilities

The Amcel plant at Asheville stands on a 1,300-acre site and is naturally divided into three areas. In one area, Amcel has located its administration, manufacturing and assembly buildings. The propellant manufacturing units and the new research laboratory are located in a second area, and the test facilities and firing range in the third. The flight test range extends from the static test cell and launch area one mile to the base of a mountain and two miles to the top of the mountain.

Amcel's static test bays are used for testing both propellants and high explosives. At present, they can handle rocket motors containing up to 10 lb. of solid propellant and producing 20,000-lb. thrust. A new test bay capable of accommodating motors with 300 lb. of propellant and in the 150,000-lb. thrust class is expected to be ready by Oct. 1. Originally, the plant was designed to turn out 1,000 8-cm. rockets or 2,000 5-cm. rockets per day on a 24-hour day production basis. Capacity of the plant for double base solid propellants is 7,000 tons/year. A composite propellant manufacturing capability is now being added to this. Amcel scientists also plan to produce liquid bipropellants, monopropellants, slurries, hybrids and just about any high energy chemical that comes along, but for the time being this will be done only at the research or experimental level.

One of management's principal concerns at this time is with keeping spending to a minimum, and this means delaying capital expenditures as long as possible. Celanese realizes that it is getting into the chemical propulsion field fairly late and, consequently, is moving cautiously. Management knows that it will have to spend money if Amcel is to come up with products that can be sold in this highly competitive field. At the same time, Celanese wants Amcel to become increasingly self-supporting as business develops and, unofficially, is reported to have set Jan. 1, 1963 as the date by which Amcel must become completely self-supporting. While this date was admittedly chosen somewhat arbitrarily, said an Amcel spokesman, some guidepost was needed for corporate planning.

Having decided to enter the rocket propulsion field, Celanese hired Julius P. Zeigler in February, 1959 to organize and direct the company's efforts along this line. Zeigler, who is now vice president and general manager of Amcel Propulsion, had been chief of engineering development of the Army's Ordnance Ammunition Command. Getting into this ball game in the fifth inning, says Zeigler, we knew we had to come in with a 38-oz. bat. This meant getting people who knew how to compete and developing products that would be significantly and demonstrably better than others on the market. In the case of rocket propellants, for example, this meant materials with at least 5 sec. higher specific impulse, greater reliability and lower temperature sensitivity.

After Celanese purchased Amcel, Zeigler laid out a tentative plan concerned primarily with getting the plant reopened, recruitment of top level technical personnel, and the construction of a 30-man research laboratory. Size of the research lab was determined by the plant's double-base propellant capacity and the desired composite propellant capability that was planned.

Three-Year Plan

Zeigler then sat down with Celanese management to formulate a three-year plan for Amcel to go into effect Jan. 1, 1960. The parent company, Celanese, does its planning on a five-year basis; but at this point in Amcel development, said Zeigler, we couldn't see five years ahead. These plans are made up in three parts: the first section deals with the capital investment required for facilities and equipment; the second part is concerned with personnel requirements; the third part is an estimate of the business or income the company can expect from its operations. This planning is broken down by quarters for the first year and annually for the next four years. The plans are then changed annually and extended for another year, but the original five-year plan is always kept for comparison with actual progress.

In July, Amcel undertook the revision of its original three-year plan to a five-year plan in order that Celanese

could incorporate it into its own planning. At this point, Amcel had its new laboratory built, had hired approximately 100 people including all the department heads, and had two small contracts to its credit. The new five-year plan is nearly complete and will go into effect on Jan. 1, 1961. The only major change anticipated, says Zeigler, is that the five-year plan will take explosive devices into account.

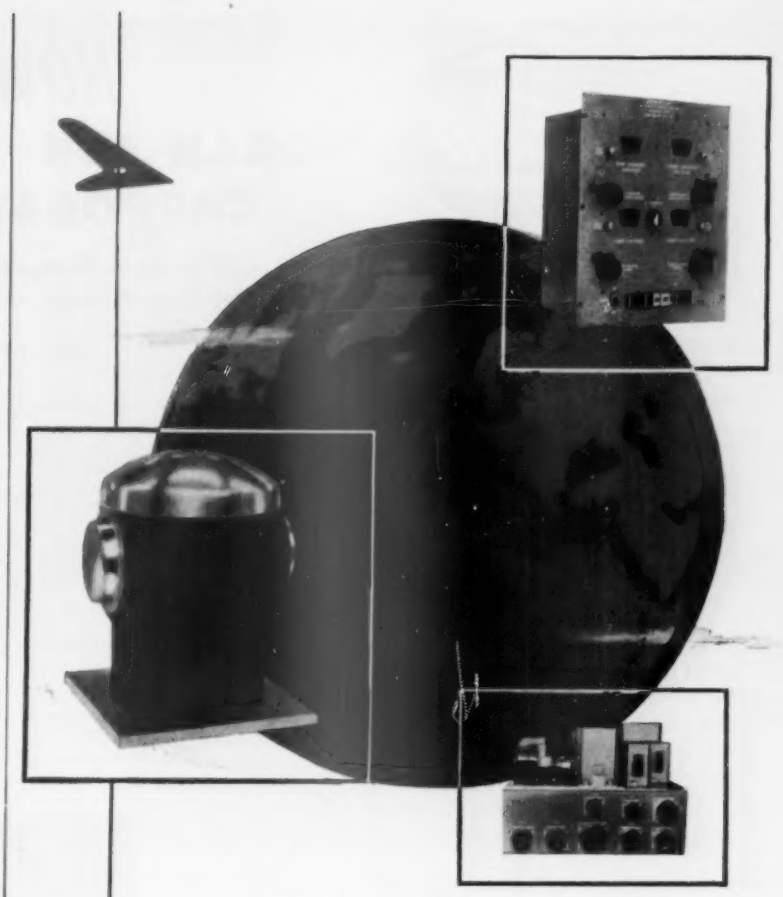
Much of the responsibility and work involved in the development of the new five-year plan was delegated to Foster G. Whitford, a chemical engineer from Celanese who became Amcel's manager of technical planning and who has been doing Amcel's process design work as well. It was Whitford's job to get both short and long-range plans from all Amcel department heads and integrate them—with alterations when necessary— into an over-all plan that Zeigler would present to Amcel's board of directors.

Five-Year Plan

Whitford's first task was to establish capital expenditure requirements. Whitford obtained a list of all capital requirements from department heads, along with the dates these would be needed, according to the individual plans worked out as a result of various planning sessions with Zeigler. Whitford did not tell these people about the Jan. 1, 1963 turning point date for fear that it would color their thinking.

Whitford listed the capital requirements and their dates on an accounting pad. Guided by experience and by the company's desire to delay heavy expenditures as long as possible, he found that adjustments were needed in the requirements and scheduling and, after talking to Zeigler, made them. In one case, for example, a department head wanted an explosives pilot plant in the first quarter of 1961 and money for a five-fold expansion of this plant budgeted for the final quarter of 1961. Whitford didn't think Amcel's explosives business would grow that fast and figured that the initial pilot facility could be expanded without spending almost five times the original investment requested. Consequently, the request for expansion funds was set back to the final quarter of 1962.

Whitford's next job was development of the working capital, primarily personnel requirements. These are determined essentially by capital requirements; the date of the capital expenditures determines the date when labor will be needed to man these facilities. Labor requirements were further broken down into professional people, operators, supervisors, clerical, indirect and packing labor. Along with personnel requirements, Whitford made an estimate of the utilities and services that



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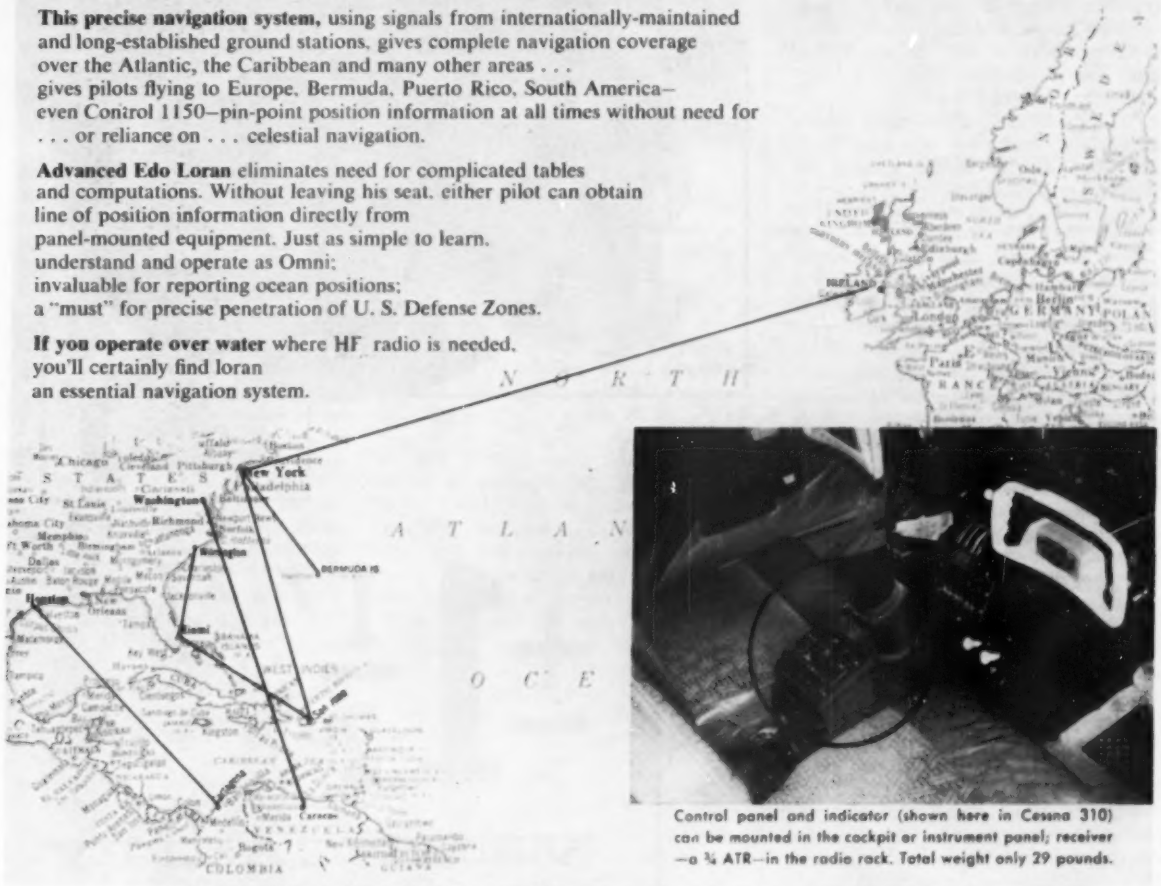
This precise navigation system, using signals from internationally-maintained and long-established ground stations, gives complete navigation coverage over the Atlantic, the Caribbean and many other areas . . . gives pilots flying to Europe, Bermuda, Puerto Rico, South America—even Control 1150—pin-point position information at all times without need for . . . or reliance on . . . celestial navigation.

Advanced Edo Loran eliminates need for complicated tables and computations. Without leaving his seat, either pilot can obtain line of position information directly from panel-mounted equipment. Just as simple to learn, understand and operate as Omni; invaluable for reporting ocean positions; a "must" for precise penetration of U. S. Defense Zones.

If you operate over water where HF radio is needed, you'll certainly find loran an essential navigation system.



Control panel and indicator (shown here in Cessna 310) can be mounted in the cockpit or instrument panel; receiver —a ¾ ATR—in the radio rack. Total weight only 29 pounds.

THOROUGHLY TESTED EDO LORAN is in daily use over Atlantic, Pacific and Caribbean air routes.
Among users who have selected Edo Loran as basic navigation equipment are:

- Aerolineas Argentinas
- Air France
- Alitalia Airlines
- BOAC
- Canadian Pacific Airlines
- Cubana Airlines
- Eastern Air Lines
- El Al Israel Airlines
- Flying Tiger Line
- Garuda Indonesian Airways
- Iberia Air Lines of Spain
- Irish Air Lines
- Japan Air Lines
- KLM Royal Dutch Airlines
- Lufthansa-German Airlines
- Northwest Orient Airlines
- Pan American World Airways
- Qantas Airways
- Sabena Belgian World Airlines
- Scandinavian Airlines System
- Seaboard and Western Airlines
- Swissair
- Transports Aeriens Intercontinenteaux—TAI
- TWA—Trans World Airlines
- Varig Airlines
- Also in use by MATS

and by growing numbers of corporate aircraft engaged in over-water operations

Edo Loran complies with FAA TSO C60

For complete information on Edo Model 345A Loran, send for Descriptive Literature to Dept. C-5.

Edo CORPORATION College Point, N.Y. Since 1925 **Edo (CANADA) Ltd.** Cornwall, Ontario

would be needed in dollars per year as well as what raw materials and supplies would be required by these people. Usually at Celanese, working capital requirements—the amount of money the company needs "in the bank" to meet all expenses— is broken down on a 30-day basis. But in Amcel's case, says Whitford, because the output will be primarily research and development with no actual products other than reports, working capital is estimated on a 90-day basis.

Working capital is essentially a revolving fund—expenses laid out by a company for a product and then payment to the company for that product. For its research and development work, Amcel is figuring payments to the company on a 90-day basis.

Business Estimate

Having completed the first two parts of the five-year plan, Whitford is now starting on the third, which is basically an estimate of the income Amcel can expect from its investment in plant, equipment and personnel. The guiding principle here will be that on Jan. 1, 1963, income must exactly balance all operating expenses.

Can Amcel meet this goal? Celanese definitely believes it can, otherwise the parent company would never have undertaken the venture, declares one executive. At Amcel itself, Zeigler and all five of his department heads are more than optimistic. The things we have to sell are product improvement, product innovation, quality control and customer service, declares one Amcel technical director; and there is not only room for all these things in the propulsion and explosives business but also a critical need for them.

As for competition, Amcel feels that its planned small operational organization and, consequently, comparatively low overhead, together with the stress on talent, quality and service, will enable the company to compete with the leaders in the field. Amcel has already taken two contracts away from established sources in the explosives fields, a department head pointed out. These were relatively small Army contracts for bursters and igniters for conventional artillery shells.

More important, he added, Amcel has a number of promising new developments under way which are expected to be ready for marketing shortly, some before the end of the year. Among these projects are the following.

• **Higher energy explosives** that can be handled in conventional processing equipment and reportedly would eliminate or significantly reduce the segregation and cracking problems that plague many current high explosives. This group at Amcel is also working on the development of higher temperature explosives that can be used with nuclear missile warheads. A comparatively small rise in the temperature limits of these chemical explosives would mean that most if not all of the presently required insulating material could be removed and a larger nuclear warhead used.

• **New rocket motors** for use with the new propellants now being developed by the Research Department are being developed by Amcel's Engineering and Development group. Before year-end, the group expects to have produced some test motors that will be used in the calibration and comparison of propellant performances.

• **Improving properties of conventional** solid rocket propellants is a major effort of the Research Department. In the future, this group plans to branch out into work on all types of propellants with the probable exception of cryogenic materials. Dr. Clayton Huggett, Amcel's research director, reports that his group is definitely interested in the development of high energy solid propellants containing fluorine.

Amcel doesn't plan to remain small forever. The company will grow, declares Fredric M. Cooper, director of Engineering and Development; but it will be an orderly growth. When we reach ICBM contractor size, he adds, we will be well prepared with a highly efficient organization, production setup and quality control program. Amcel will profit from the mistakes made by the first generation contractors; but more important than that, says a company executive, is the fact that management is spending its own money, not the government's. Nobody in Amcel is getting a free ride, he adds; they have got to be good or go out of business.

ASW Package Loaded on Vertol YHC-1

Modular package containing complete sonar equipment for anti-submarine "dipping" mission is loaded aboard Vertol YHC-1 twin-turbine helicopter. Package includes space for two operators, has design weight of 1,500 lb. complete. Series of these modular units has been developed to allow mission versatility; aim is to make each package capable of being installed in a maximum of one hour. Other units contain equipment for towed sonar and minesweeping. Vertol Model 107 civil transport version will have a baggage module which can be plugged in and pulled out at stops to reduce ground time. Baggage module will form outer rear surface of fuselage, will plug in like a cork in a bottle rather than being trundled into the fuselage forward of the rear rotor.

NASA Contracts

The National Aeronautics and Space Administration awarded the following contracts, totaling more than $134 million, during the period Jan. 1, 1960, through June 30, 1960. The figures shown represent the estimated total cost of the contract.

LEWIS RESEARCH CENTER, Cleveland, Ohio.

Del Electronics Corporation Mt. Vernon, N. Y.—$34,010—Electrical power supplies for amplifiers.

Lieb Jackson Columbus, Ohio—$130,856—Cryogenic and associated piping for Plum Brook.

The Herkner Construction Co. Cleveland, Ohio — $349,911 — Roadway, underground services and sewage pumping station.

Universal Marine Construction Co. Sandusky, Ohio—$59,500—Electrical equipment and wiring for Plum Brook.

William Passaiacqua Builders, Inc. Cleveland, Ohio—$1,127,500—Construction of Ion

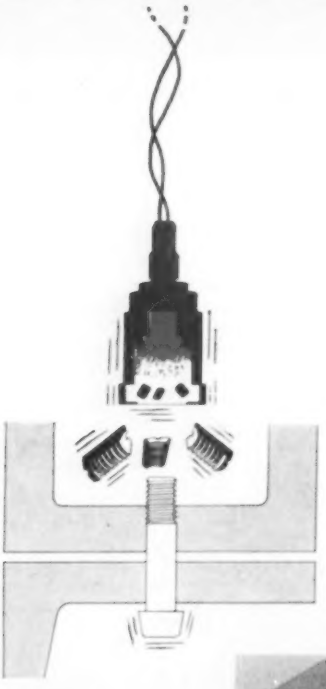
TYPICAL APPLICATIONS

- SEPARATION OF MULTI-STAGE VEHICLES AND NOSE CONES.
- RELEASE FROM LAUNCHING PADS.
- RELEASE OF BOOST ROCKETS AND LAUNCHING SLEDS.
- RELEASE OF TANKS AND JETTISONABLE ITEMS.

FOR SEPARATION SYSTEMS

THE NEW

SEPARATION NUT



A unique, safer and more efficient method for separation systems is offered by the Separation Nut.

The Separation Nut is unique because its controlled separation is a highly reliable mechanical function activated by a very small explosive charge.

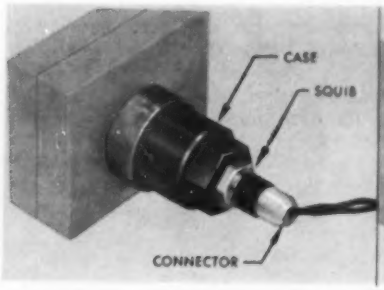
By using the Nut's small explosive charge rather than the "brute force" explosive techniques so commonly used to fail high strength material in explosive bolts, the Separation Nut can substantially reduce a potentially hazardous condition to installation crews and to the vehicle itself.

More compact joints can be designed since Separation Nuts are used in combination with standard diameter, high strength bolts used at full allowables.

Separation Nuts reflect another new fastening concept developed in Hi-Shear's specialized engineering and laboratory test facilities for the specific needs of space vehicles and high performance aircraft.

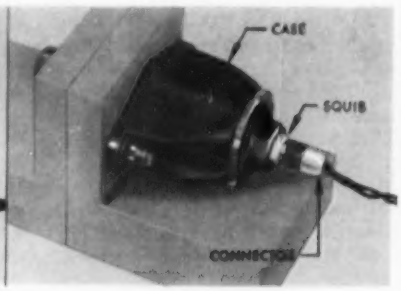
Write for brochure . . . describes how the Nut works, high speed photos, design goals, typical applications and summary of the test program.

PATENT APPLIED FOR.



NON-CAPTIVE NUT

Basic configuration . . . accommodates bolt thread sizes including ¼-28 thru ¾-16.

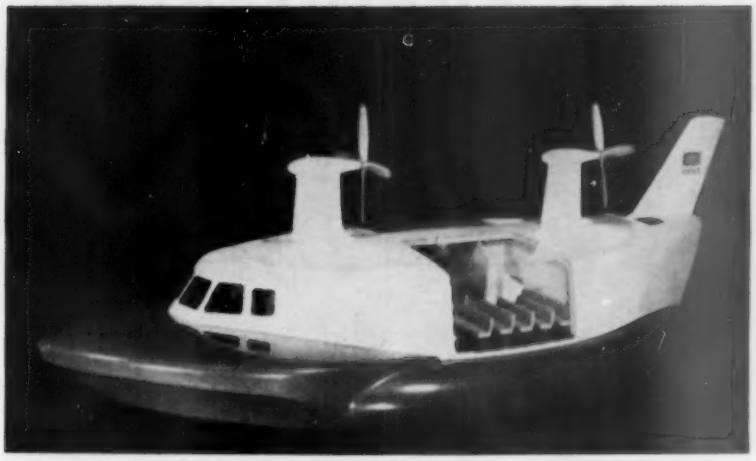


CAPTIVE NUT

Because only a low explosive charge is used, all fragments can be easily contained by Nut's case. A similar case can arrest a bolt after detonation.

hi-shear CORPORATION

2600 WEST 247TH STREET, TORRANCE, CALIFORNIA, U.S.A.



Saunders-Roe N2 Hovercraft

N2 Hovercraft (mockup), was designed and is being built by the Saunders-Roe Division of Westland Aircraft, Ltd., as a joint venture with Britain's National Research Development.

and Plasma Jet Facility Office and Operations Building.

The Feldman Brothers Co. Cleveland, Ohio—$401,200—Altitude exhaust system for the altitude rocket test facility for Plum Brook.

T. J. Hume Co., Lorain, Ohio—$380,146—Construction of a pump house, heat sink and associated equipment for altitude rocket test stand.

Chicago Bridge and Iron Co. Cleveland, Ohio—$524,900—Fabrication, erection and cleaning two vacuum tanks.

T. J. Hume Co. Lorain, Ohio—$229,793—Construction of a test stand for Plum Brook.

Ampex Data Products Co. Dayton, Ohio—$26,135—Magnetic tape loop.

Consolidated Vacuum Corp. Columbus, Ohio—$28,650—High vacuum and mechanical pumps.

Instron Engineering Corp. Canton, Mass. —$24,652—Construction of remote control tensile testing facility at Plum Brook.

General Vacuum Corp. East Boston, Mass.—$35,082—High vacuum valves.

M. B. Electronics, Division of Textron Electronics, Inc. New Haven, Conn.—$25,426—Complex motion testing system for Plum Brook.

The Brush Beryllium Co. Cleveland, Ohio —$261,454—Beryllium reflector assemblies, control rod pieces and plates for facilities at Plum Brook.

Linde Company, Division of Union Carbide Corp. New York, N. Y.—$383,402—Liquid helium system.

Ronan & Kunzl, Inc. Marshall, Mich.—$31,208—Cryogenic tanks for Plum Brook

Project Fabrication Corp. Long Island, N. Y.—$141,658—Liquid hydrogen transport dewars.

Graybar Electric, Inc. Cleveland, Ohio—$35,848—Instrument and control cable for Plum Brook.

Dalton & Dalton Associates Cleveland, Ohio — $48,200 — Architect/engineer service for part one of the Ion and Plasma Jet Facility.

Heintz Division, Kelsey-Hayes Philadelphia, Pa.—$29,320—Services and material to fabricate, machine and assemble 10 rocket engines.

Linde Company, Division of Union Carbide Corporation New York, N. Y.—$85,708 —High pressure gas pump and vaporizer.

Electronic Associates, Inc. Long Branch, N. J.—$38,550—Analog computer.

LANGLEY RESEARCH CENTER, Hampton, Va.

General Dynamics Corp., Electric Boat Division Groton, Conn.—$108,931—Services and material for an arc chamber assembly, test section assembly, nozzle extensions.

A. O. Smith New York, N. Y.—$896,000—Services and materials for high pressure air and gas storage fields.

J. E. Wray and Company Williamsburg, Va.—$51,500—Services and materials for addition and alteration to impact basin.

Tele-Dynamics, Inc. Philadelphia, Pa.—$26,235—Amplifiers and oscillators.

G. T. Schjeldahl Company, 202-206 Division Northfield, Minn.—$29,764—Services and material to furnish spherical balloons for Project Echo.

Western Electric Company, Inc. New York City, N. Y.—$33,058,690—World-wide tracking system for Project Mercury.

Research Incorporated Minneapolis, Minn. —$31,831—Services and materials for designing, manufacturing and delivery on one controller.

Kaiser Fleetwings, Inc. Bristol, Pa.—$37,812—Services and materials for six 100-foot inflatable satellite container assemblies for Project Echo.

The Mickle Company, Div., Mickle-Fors-Dexter, Inc. Chicago, Ill.—$50,154—Presses, offset.

Henry Leonard Chincoteague, Va.—$50,000—Alterations and additions to NASA Administration Building at Wallops Island.

Curtiss Wright Corp., Santa Barbara Division Goleta, Calif.—$24,155—Services and materials for E48 pilotless aircraft models.

Perkin-Elmer Corporation Norwalk, Conn. —$29,610—Diffuse reflectometer system to determine reflectivity of materials used in constructing space vehicles.

J. W. Fecker, Division of American Optical Co. Pittsburgh, Pa.—$305,000—Services and material for the design, furnishing and installation of long focal-length tracking telescope facility at Wallops Island.

High Vacuum Equipment Corporation Hingham, Mass.—$27,683—Services and materials to design, fabricate and deliver a vacuum system.

W. H. Scott, Inc. Franklin, Va.—$29,877 —Services and materials for roadway extension at Wallops Island, Va.

E. C. Ernst, Inc. Washington, D. C.—$155,934—Services and materials for electrical data transmission network at Langley Field, Va.

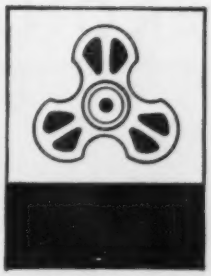
Data Instruments, Division, Telecomputing Corporation North Hollywood, Calif.—$49,975—Services and material for basic systems of telereading equipment for Project Mercury.

Boonshaft & Fuchs, Inc. Hatboro, Pa.—$89,500—High capacity hydraulic loading apparatus.

Ampex Corporation Washington, D. C.—$57,475 — Magnetic recording-reproducing system.

Aico Products, Inc. Dunkirk, N. Y.—$391 080—HI-Pressure HI-Temperature combustor.

Aerojet-General Corporation, Solid Rocket Plant Sacramento, Calif.—$946,043 —Rocket motors, test and transtainers for Project Scout and Air Force 609A Program.



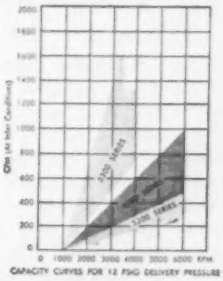
3-LOBE DESIGN

Exclusive M-D 3-lobe design adds strength—reduces torsion. Dynamically balanced rotor permits higher speeds —greater pressures.

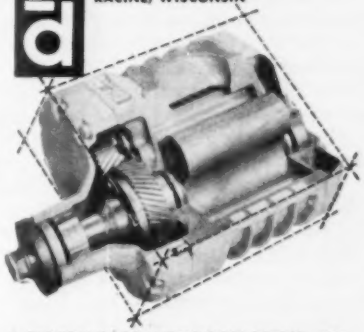
Why M-D rotary positive blowers develop higher pressures . . .

The unique combination of precision manufacture and modern design found only in M-D rotary positive blowers permits higher speed operation and higher pressures. For this reason M-D can furnish greater air flow at lower initial cost.

M-D blowers operate at wider pressure and speed ranges than any other rotary positive blower. Capacities of 22 production models range from 50 to 4,000 CFM, pressures to 14 PSIG single, 70 PSIG multi-stage.



M-D BLOWERS, INC.
RACINE, WISCONSIN



A SUBSIDIARY OF MIEHLE-GOSS-DEXTER, INC.

B-47s AND B-52s are lined up in munitions loading area for judging of equipment and procedures in nuclear-arming these bombers.

B-58A Wins SAC Radar-Bombing Event

Bergstrom AFB, Tex.—Convair-Ft. Worth's B-58A Hustler supersonic bomber weapon system successfully passed a significant milestone by taking first-place honors in the radar bombing portion of Strategic Air Command's hard-fought 12th annual combat competition here.

Although the Hustler and its award-winning crew, headed by Maj. Harold E. Confer, of the 2nd Air Force's 43rd Bomb Wing, Carswell AFB, N. M., came in fifth at the conclusion of the two days of strenuous flight activity, their performance received top notices from high-ranking SAC officers and visiting Royal Air Force Air Marshal Sir Kenneth B. B. Cross, commander-in-chief of Bomber Command, who observed the exercise.

Pitted against aircraft having years of operational service, flown by crews numbering their experience with these planes in the thousands of hours, and without the extensive depot backup for spares that its Boeing B-47 and B-52 rivals could muster, the Hustler scored a unique success, in the opinion of high-ranking military observers here, considering that it had less than two months of operational service on its log and that its crew numbers time in the airplane in the neighborhood of 300 hr. These observers could not recall any previous SAC competition where an airplane had been entered with so little service life behind it.

SAC Commander-in-Chief Gen. Thomas S. Power told participants at the conclusion of the meet that if it had not been for a minor mechanical problem, the B-58 might well have won the entire competition.

These sentiments were backed up by Gen. Power's deputy director of operations, Maj. Gen. Keith K. Compton, who noted that with this competition SAC has come into a new era of the manned force. "The superb bombing of the B-58 in this competition definitely proves that this is even now more apparent when you realize that SAC accepted the B-58 weapon system only a short six weeks ago."

Minor mechanical items, which inflicted such heavy losses on the Hustler's scoring potential, included failure of a small spring steel strip in the squeeze-type bombing-navigation tracking handle, which caused the spring to fall down and short terminals near the base of the handle so that the cross-hairs on the radar went awry. This caused the airplane to be flown off course—completely out of its prescribed corridor—during the low-level navigation run on its first mission, and resulting in a zero score out of a possible 100 points for this event.

This was the first time this malfunction had occurred, according to a company official.

Low Level Run

The second night, the Hustler scored zero again on its low-level navigation run when a film magazine jammed, preventing monitoring of the airplane's performance. This total loss of 200 critical points probably was the key factor in determining the Hustler's final standing, since only 137 points separated Maj. Confer and his crew from the final over-all winner, a Boeing B-52 from the 11th Bomb Wing, Altus AFB, Okla., which scored a final 1,183 points out of a possible 1,600 to win the Fairchild Trophy for the top bomber unit in the combat competition. The 11th, incidentally also scored a precedent with its win, by taking the trophy for the third time.

The Hustler also racked up these impressive scores on other portions of the mission: 100 out of 100 on the alert and scramble during each of the two nights; 98 out of 100 on tanker rendezvous and refueling on the first night's mission and a perfect score on the second night; 66 points out of 100 on the electronic countermeasures mission the first night, a perfect score the second night.

The SAC combat competition this year varied from previous years in at least two important aspects. Number of participants were far fewer, because with the growth of the command it was decided to hold preliminary eliminations within each numbered air force to narrow down the entrants—this year there were 52 crews involved, whereas in 1959, with no eliminations, 188 crews participated. Low-level navigation and bombing runs were used for the first time to check the effectiveness of SAC's low-level target penetration techniques, on which crews have been gaining proficiency this past year. One of the great values of these competitions, SAC has found, is that it provides a very effective incentive in building up proficiencies in critical combat requirement areas.

This was proven, officers point out, when demobilization degraded USAF's bombing capability after World War II; the competition was started to rebuild this proficiency. By the spring of 1948, SAC units' bombing efficiency had fallen considerably below standards required for the strategic bombing

mission, and the command initiated a competition emphasizing correction of circular error probabilities. In the short period between the first competition in June, 1948, and the time SAC went to Korea in 1950, proficiencies had climbed to where its B-29s bettered World War II peak records of sorties flown and tons of bombs per plane delivered on targets. In less than two months, the strategic bombing mission over Korea was completed, radar bombing in particular being so effective that weather proved much less of a factor than planners had contemplated. This year, too, the alert and scramble procedure was incorporated in the scoring.

Procedure was to have each plane parked inside a painted 125-ft. circle. All competing aircraft had to be readied by their maintenance crews to the SAC "cocked" configuration, fueled and power units and switches positioned for instant starting not later than 1½ hr. prior to the time the flight crews gathered in assembly areas to await the scramble signal, which was given them at a time unknown to them in advance.

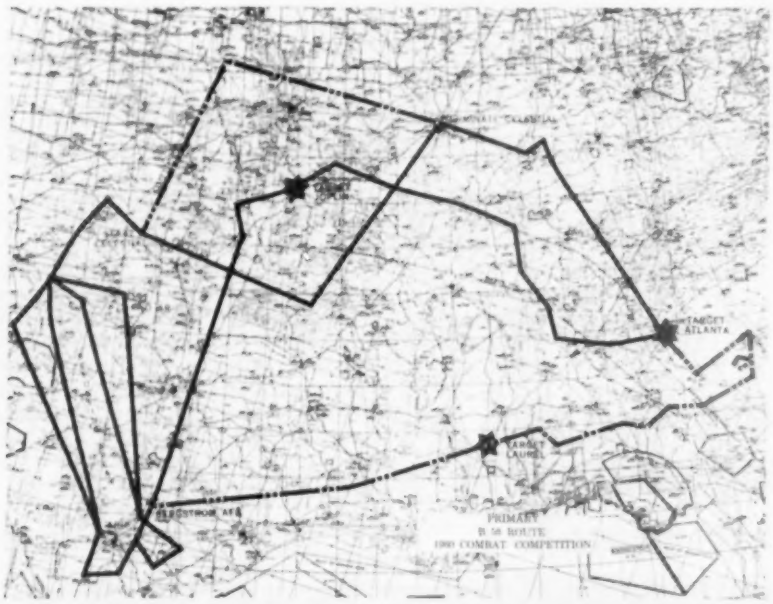
After cocking was completed by the crew and recorded by the scoring official assigned to each airplane, zero points were awarded if aircraft or equipment maintenance was performed. No one, except the scorer, was permitted to cross the red-line circle, until the flight crew arrived and the scorer signaled the "go." There was loss of 10 points off the total of 50 for each 15 min. elapsed after the cocking deadline.

CONVAIR B-58A TEAM SCRAMBLES on the evening of the first day of combat competition flying. The air crew scrambles from alert vehicle to cocked aircraft to open flying portion of bombing competition at Bergstrom AFB, Tex.

Scramble time started when the aircraft commander's name was called in the assembly area and ended when the airplane started rolling. Time allotted were (bombers): B-58, 7 min. 11 sec.; B-52B through F, 8:05, B-52G, 8:35 and B-47, 7:54. Tanker scramble times were: KC-135 (for B-58), 6:05, KC-97 (for B-47), 7:18 and KC-135 (for B-52), 8:17.

Observers noted that the B-58 scrambled in about half the time required by other bomber types, although no points were credited for beating the minimum. This was accomplished by the crew—only four ground crew personnel were permitted to assist the three-man flight crew in the scramble—despite feelings prior to the start of the competition that times allotted were too tight because the crew loading stand was heavier and more unwieldy than it was accustomed to using at Carswell and the fact that the Solar turbine starter required some 20 sec. to get up to power.

B-58 flight plan called for Bergstrom AFB departure, flying northwest into the refueling area. Initial contact control time (ICCT) with the KC-135 also was a scored item, with a hookup within zero to plus 30 sec. of scheduled ICCT providing maximum points. B-58 was allowed ICCT plus 10 min. to take on its preprescribed fuel load of no less than 40,000 lb. of fuel for maximum scoring. Delays by either the bomber or tanker in scramble or making one prescribed ICCT would diminish the amount of fuel that could be taken on.



SOLID BLACK LINES show B-58s route; broken line was alternate for weather conditions. Supersonic high-level run was made on Atlanta; low-level run was made on Joplin.

Hydraulic Failure

In one instance, a KC-97 suffered a failure of hydraulics that made it impossible to operate its fueling boom, thus the B-47 it was scheduled to load had to abort and lose all points for the remainder of that mission.

After refueling, the B-58 started its night celestial navigation leg at Buffalo, Okla., flew southeast to Little Rock, Ark., then northeast and ended the celestial leg at St. Louis, Mo. The crew then flew southeast and made a high-altitude bomb run at approximately Mach 1.5 on its target in Atlanta, Ga., which was the northeast corner of the northernmost warehouse of J. R. Morris Co., located at Stuart and Glenn Streets. The supersonic run on Atlanta set off a sonic boom, for which the residents had been forewarned.

After the high-level run, the airplane made a low-level 1,000-ft.-altitude target penetration on Joplin Mo., and returned to Bergstrom. Longest distance provided for the B-58 mission to cover 2,937 naut. mi. with a no-wind flight time of 5 hr. 17 min.

New Fuels Have High Heat Sink Values

New York—Liquefied hydrocarbon gases may hold the key to the heat problem of high speed flight. Robert R. Hibbard of NASA's Lewis Research Center reported to the American Chemical Society here that the low molecular weight hydrocarbon gases such as methane, ethene and propane appear far superior to current JP-type fuels as heat sinks for future high speed aircraft.

The ability of current aircraft fuels to sop up heat from the engine lubrication system, fuel pump and combustion process is already being taxed to and beyond its limit in certain missions, Hibbard says. As a result, the fuel formed solid degradation products which have fouled lubricant-to-fuel heat exchangers and clogged engine fuel injectors.

In future turbojet or ramjet-powered aircraft, each pound of fuel may be required to soak up 500 to 1,000 Btu. in place of the 150 to 200 Btu. now required. Besides the three current cooling requirements, future aircraft are likely to require fuel cooling for refrigerating cabins, payloads or even wheel wells, for lowering the temperature of advanced turbojet turbines and ramjet exhaust nozzles, and for cooling the airframe, particularly leading edge structures.

Of the seven fuels considered by Hibbard, methane is listed as having the highest heat sink capacity with 1,085 Btu./lb. Then come: ethene, 785 Btu./lb.; propane, 705 Btu./lb. a blend of isopentane (42%) and isohexane (58%) 595 Btu./lb.; aviation gasoline, 560 Btu./lb.; JP-4 (a highly naphthenic, kerosene-type fuel made for an advanced ramjet engine), 545 Btu./lb.; and JP-4, commercial wide-boiling-range jet fuel, 165 Btu./lb.

Owing to their low density and high volatility, the first three fuels—methane, ethene and propane—would present a number of problems in aircraft use. Some of these would be similar to the problems associated with cryogenic liquid rocket propellants, but most of the problems Hibbard feels, can be solved.

For one thing, these fuels used in a volume-limited aircraft designed for JP-type fuels would result in reduced

Fuel	Initial temperature, °F	Final temperature, °F	Vapor pressure at final temperature, atm	Vaporization assumed	Heat-sink capacity, Btu./lb.
Methane	−259	1000	(b)	Yes	1085
Ethylene	−155	985	(b)	Yes	785
Propane	−44	855	(b)	Yes	705
Isopentane-isohexane	100	825	(b)	Yes	595
Aviation gasoline	100	780	(b)	Yes	560
JP-4	100	400	7.6	No	165
JP-z	100	825	(b)	Yes	545
	100	800	20	No	435

TABLE prepared by NASA's Robert Hibbard shows that liquefied hydrocarbon fuels offer much higher heat sink capacity than conventional JP-4 jet fuel. Final temperature of methane is assumed to be limited to 1,000F by exchanger drive temperature, while JP-4 is assumed to be gum-limited at 400F. Letter "b" means "above critical temperature."

	Methane	Ethene	Propane	Isopentane-isohexane blend	Aviation gasoline	JP-4 fuel	JP-z fuel
Specific gravity, 60°/60°				0.644	0.693	0.773	0.854
Freezing point, °F	−296	−273	−306	−279		−85	−75
Boiling point, °F	−259	−155	−44	104[a]	145[a]	210[a]	455[a]
Critical temperature, °F	−116	50	206	400	500	640	825
Net heat of combustion, Btu./lb.							
From liquid fuel				19,247	19,070[b]	18,680[b]	18,500[b]
From gaseous fuel	21,500	20,275	19,930	19,395	19,240	18,840	18,645
Lean flammability limit							
Per cent by volume	4.4	2.7	2.0	1.2	1.0	0.80	0.56
Fuel-air ratio	0.027	0.028	0.033	0.034	0.034	0.035	0.035
Rich flammability limit							
Per cent by volume	15.5	>39	11.4	7.9	6.7	5.6	4.3
Fuel-air ratio	0.095	>0.41	0.18	0.24	0.25	0.26	0.28
Spontaneous ignition temperature °F	1170	914	940		844	502	475
Maximum fundamental flame velocity, cm./sec.	37	75	43	40	38	38	40

TABLE compares properties of JP-4 and several hydrocarbon fuels that may find use in future aircraft. Superscripts "a" and "b" respectively indicate bubble point and "from correlation with aniline-gravity product." Flame velocity of JP-z fuel is estimated.

Fuel	Initial fuel temperature, °F	Holding time, hr.	
		Interceptor	Bomber
Methane	−259	3.8	6.6
Ethane	−155	6.6	11.7
Propane	−44	16.6	30.2

LIQUEFIED gases severely limit aircraft holding times. Table gives runway holding times before fuel vapor pressure exceeds 2 atmospheres absolute and assumes an ambient temperature of 80F.

range. On the other hand, these fuels offer higher heats of combustion which could negate the range penalty if used in aircraft specifically designed for them, says Hibbard. In fact, in an anaylsis of two different missions, Hibbard shows that the higher heats of combustion more than offset the lower densities to give an actual range increase. Moreover, at the current stage of development in combustor design, studies indicate better combustion efficiencies can be expected under the more severe flight conditions such as cruise and loiter when fuels are vaporized. Also, says Hibbard, all these fuels except JP-z should greatly ease the combustor coking and smoking problems encountered with JP-4-type fuels.

High volatility of these fuels, particularly the first three which are gases under normal conditions, would create more serious problems. Perhaps the most critical of these problems is the limited holding times that the liquefied gas fuels would allow. In the case of methane, which has the lowest boiling point (−259F) and would be the most critical, this time is 3.8 hr. for an interceptor and 6.6 hr. for a bomber. Aircraft could not be kept in constant readiness without auxiliary refrigeration equipment, says Hibbard. A possible alternative, he suggests, is permitting the fuel to be vaporized at one atmosphere through vents and then topping the tank just before takeoff.

Another aspect of this problem to be considered is ground icing. Outside surfaces of tanks fueled with liquefied hydrocarbon gases would be below 32F while the aircraft is on the ground and, consequently, would collect frost or ice. It is not known whether this additional weight would hamper aircraft operations, says Hibbard; and he does not go into possible solutions.

The normally liquid fuels, the isopentane-isohexane blend and aviation gasoline, could be held indefinitely, says Hibbard. Although the heat-sink capacities of these fuels are less than those of the liquefied gases, they are much better than that of JP-4 and would be

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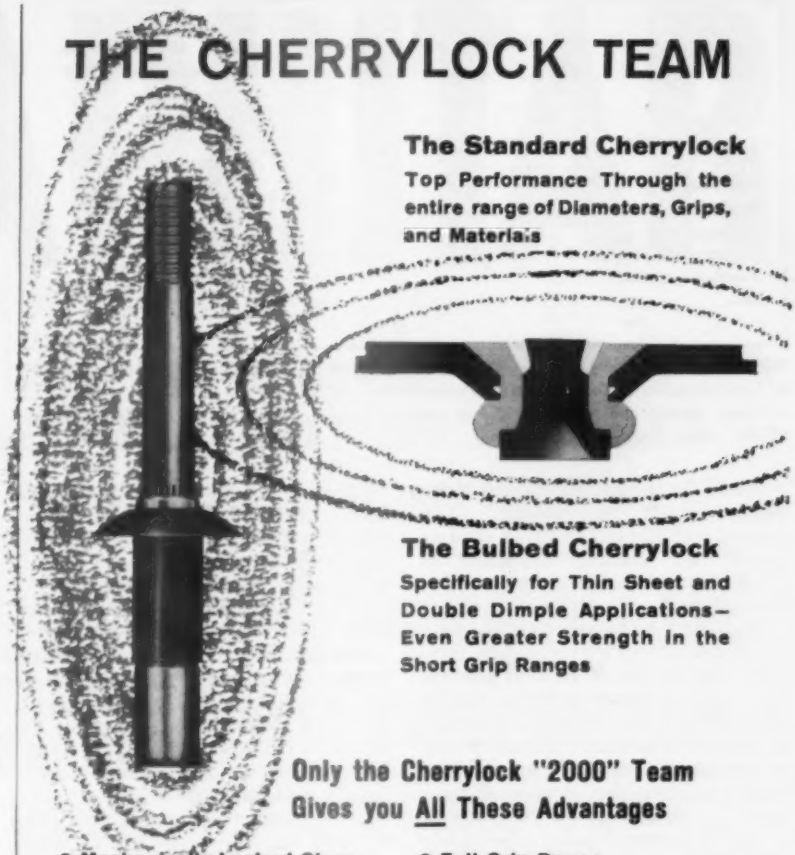

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CHERRY RIVET DIVISION

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Fuel	Initial temperature, °F	Aircraft range relative to that obtained with JP-4	
		Interceptor	Bomber
JP-4	100	1.00	1.00
Methane	−259	1.11	1.15
Ethene	−155	1.07	1.11
Propane	−44	1.05	1.07
Isopentane-isohexane	100	1.02	1.04
Aviation gasoline	100	1.03	1.03
JP-x	100	1.02	1.01

COMPARISON of fuels with regard to aircraft range is intended to show the over-all effect of lower densities and higher heats of combustion. It is based on an arbitrary selection of missions, aircraft and engines. JP-4 is considered to reach the engine in a liquid phase; all the others, in the vapor phase.

adequate for a large number of anticipated aircraft requirements. This coupled with the fact that they need no special fuel handling equipment or techniques makes these fuels attractive, Hibbard feels.

High rates of in-flight fuel vaporization is another problem posed by these fuels. In the case of aviation gasoline, this is only a minor problem even at high altitudes, says Hibbard, and could be solved by a moderate amount of tank pressurization. For the liquefied gases, studies indicate that cylindrical tanks carried in the fuselage and covered with a ½-in. of expanded polystyrene insulation would keep fuel vaporization rates far below engine consumption rates.

Ground Storage

On the ground, the liquefied gases would require new types of storage and fuel handling techniques, Hibbard says, if they are to be used in aircraft. But according to recent reliable estimates, he points out, liquefied methane, the most critical of the gases, could be stored in bulk at a cost of approximately 50 cents/gal., a figure not out of line with the 10 cents-25 cents/gal. cost for the storage of conventional fuels.

Hibbard notes the fact that methane, propane and modified aviation gasoline are all readily available in sufficient quantities and at reasonable costs. In fact, says Hibbard, in cost and availability, liquid methane probably comes out ahead of conventional aircraft fuels. It is estimated that the delivered cost of liquid methane would run 25 cents to 45 cents per million Btu. compared with approximately 85 cents per million Btu. for JP-4.

Costs of propane and aviation gasoline per Btu. would be comparable to that of conventional JP fuels. The aviation gasoline, says Hibbard, is avgas only in terms of volatility; used for jet fuel, it would need no octane number.

Airline Utilization of Kerosene Fuels Reduces Fire Accidents

New York—Use of kerosene fuel has resulted in a lower fire rate in airline accidents than that experienced with aviation gas, according to M. G. Beard, of American Airlines.

Reviewing 18 months of airline jet operations with kerosene, Beard told American Chemical Society members meeting here that the carriers have adapted more easily to kerosene than previously to high-octane gasoline.

Regarding accident fire safety, Beard said a study of 86 accidents during the period Jan. 1, 1959 to July 31, 1960 show that 53 involved gasoline and 33 involved kerosene. Of the accidents in which gasoline was the fuel, 23 or 43.5% resulted in fires. Of the accidents involving kerosene, seven or 21% resulted in fire.

Fatal accidents numbered 31 of the total, and of the fatal accidents, fires occurred in 17 or 81% of those involving gasoline and six or 60% of those involving kerosene.

The figures cover world-wide accidents with fire potential involving scheduled, supplemental and all-cargo fixed-wing airlines in revenue and non-revenue flying.

Safety Comparison

A similar comparison of the safety characteristics of kerosene and JP-4 as used in military transports has not been made, Beard said. Also, few figures exist with which to compare the fire safety record of kerosene and JP-4 in commercial operation.

Operational handling of kerosene fuel has not posed any serious problems, the American official said, and in some areas kerosene has proved easier to handle than gasoline. Airlines have respected other areas where kerosene offers a greater hazard and by adhering to safety standards have produced a good operation with respect to fires.

Generation of static electricity has been considered a major hazard in handling kerosene. After the airlines decided to use kerosene rather than JP-4, fuel companies began investigations of this characteristic of kerosene. Final phase of a research program into the problem is under way by the coordinating research council, covering both kerosene and JP-4.

Previous Research

Previous research had indicated, according to Beard, that some static discharges within an aircraft tank may contain several times the minimum energy for ignition of the most readily inflammable mixtures.

Fuel spills had been an anticipated source of difficulty, particularly on asphalt ramps, Beard said. But experience with Lockheed Electra, Boeing 707, Douglas DC-8 and Convair 880 underwing fueling has shown a reduction in fuel spills and, if anything, cleaner ramps. Oil drippings from drain lines of piston engines are a major cause of dirty ramps. The new concrete ramps at the jet gates at Idlewild, Beard said, are still white and clean, whereas the new piston gates are already stained with oil.

Since engine manufacturers generally had believed JP-4 would be the U.S. commercial jet fuel, engine manufacturers had concentrated on that fuel and had little service experience with kerosene, Beard said.

But mechanically, jet engines apparently have tolerated whatever differences exist between kerosene and JP-4 with little distress.

Turbine engine fuel requires especially good "house-keeping" in handling from carriers to airplanes, according to Beard. It is more difficult to keep clean. Among the problems in using it have been failure of fuel quantity gages, which at one time were "epidemic" and led to delayed schedules and considerable maintenance expense. Reason for this turned out to be water in the kerosene, which would short out the tank probes and cause the gage system to indicate incorrectly. During shipment of the probes to overhaul bases, they would dry out and an inspector could find nothing wrong.

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at a station close to a refinery. Kerosene delivered directly to storage tanks was pumped in at the same time fuel was going into trucks from the same tanks.

Mixing of gasoline with kerosene was practiced during the early U.S. jet operations, Beard said, when kerosene was available only at a relatively few airports. In diversions or other operations off scheduled routes, aviation gas was mixed with residued kerosene in the tanks. Engine manufacturers permit gasoline to be used on an emergency basis only, mainly because of lead deposits produced on injection nozzles, combustors, guide vanes and buckets and lower takeoff thrust. From an operator's point of view, use of gas increases the fire hazard.

Mixing of gasoline and kerosene even in emergencies was stopped, Beard said, following a tank truck fire at Chicago after the two fuels had been accidentally mixed. While this accident was not directly attributable to the mixture, indications were that the hazard is greater with the mixture than with either fuel alone. Occasionally North American airline operators find it necessary to mix kerosene and JP-4, and overseas operators find kerosene unavailable and use JP-4 when necessary.

Tank Coatings

To help keep kerosene clean, oil companies recently have been experimenting with coatings for inner surfaces of storage tanks, pipelines and tank to prevent rust and scale contamination. Relatively few tank trucks are coated and economics of coating are not yet conclusive.

One Vickers Viscount operator had no difficulty of this kind during the first two and a half years, using uncoated fuel trucks. After that time, problems with Rolls-Royce Dart engine fuel controls and pumps developed because of foreign matter in the fuel and the airline now is having its trucks coated.

Big carriers which began turbine operations in 1958 and 1959 have not experienced such problems at least as yet. Another year may be required to indicate whether the Pratt & Whitney engines, with low pressure fuel systems can tolerate contamination which handicapped the higher pressure Dart fuel system.

One difficulty in development of commercial turbine fuels was determination of freeze point. After extensive test, most U. S. domestic operators have specified a minus 40F freeze point. Both U. S. transatlantic operators set the freeze point at minus 58F with the kerosene.

In the 18 month period, lowest wing tip tank fuel temperature recorded in domestic operation was minus 34.5F at completion of a trancontinental flight.

PRODUCTION BRIEFING

Air Products, Inc., liquid hydrogen daily production capacity for the Air Force has reached 68,500 lb., with two Florida plants producing 60,000 and 7,000 lb. respectively. Painesville, Ohio, plant produces 1,500 lb.

General Electric Missile and Space Vehicle Department is conducting design study of a self-contained, full-pressure space suit under $80,531 Air Force contract.

Army Nike Hercules has intercepted and destroyed another Hercules at 19-mi. altitude over White Sands Missile Range.

Transfer of missile base construction responsibility to new Army Corps of Engineers Los Angeles Ballistic Missile Construction Office has begun with shift of Denver Titan complex from Omaha District Engineer. Plattsburgh AFB and Ellsworth AFB Atlas construction responsibility has been transferred to Los Angeles office.

Sperry Gyroscope Co. will produce wide-range passive underwater detection system for subs under a $4.5 million Bureau of Naval Weapons contract.

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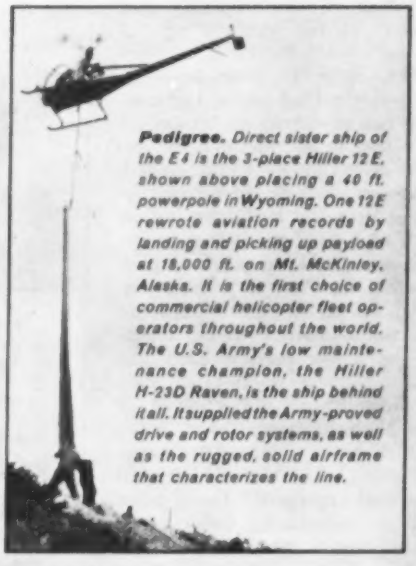

Pedigree. *Direct sister ship of the E4 is the 3-place Hiller 12 E, shown above placing a 40 ft. powerpole in Wyoming. One 12 E rewrote aviation records by landing and picking up payload at 18,000 ft. on Mt. McKinley, Alaska. It is the first choice of commercial helicopter fleet operators throughout the world. The U.S. Army's low maintenance champion, the Hiller H-23D Raven, is the ship behind it all. It supplied the Army-proved drive and rotor systems, as well as the rugged, solid airframe that characterizes the line.*

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Industry Pushes Turbine Engine Plans

By Erwin J. Bulban

Los Angeles – Rapidly building ground swell for light turbine engines in business aircraft evidenced here at National Business Aircraft Assn.'s 13th annual meeting and forum indicates that it is reaching the point where timing of announcement of plans is becoming a critical factor to airframe builders' management.

A major reason for delay in making the big announcement appears to be commercial rather than technical. The small powerplant spectrum has become well defined and the engine manufacturers are generally in a position where they are now able to talk costs and deliveries (AW Sept. 5, p. 30).

But a crucial year for marketing new piston-engine lines, representing costly design changes, lies ahead. Few builders relish the thought of compromising sales of these airplanes and striking what could be a damaging blow to their distribution organizations in the year ahead by premature revelation of turbine plans. Both engine and airframe manufacturers are also desirous of getting results of planned testbed programs using currently available airframes to prove out paper calculations and cost data.

It seems apparent that the initial generation of turbine-powered light and medium-size business planes will be turbine-powered versions of piston-engine current types, since this approach will most effectively keep airframe costs down.

Engine manufacturers are working on testbed programs to speed the time of application of engines to airframes. Boeing plans to refit a Grumman Widgeon amphibian with its 250-hp.-class Model 502 and Canadian Pratt & Whitney is putting its 500 hp. PT-6 (T70) in the nose of a Beech 18. Indications are that General Electric has plans to flight test its CF-700 turbofan in a business plane.

Boeing told business pilots here that it can offer 30-60 day delivery of the Model 502 at approximately $10,000; the company is currently certificating the engine toward a 270-hp. continuous rating and 325 hp. maximum power. The higher-powered 520, which Boeing says it can deliver for prototype installations in 90 days for approximately $20,000, can be tooled for production next year, a company representative reported. In production, the price would go down to the $12,000-$14,000 range, with normal overhaul costs running $1,800-$2,000 at 1,000 hr. if it is not necessary to replace the engine's hot section. The lighter Model 502 price would probably go down to approximately $8,000 in 1962 and be well below that in 1964, a Boeing representative indicated.

Continental, which believes that the 500-hp. class holds the best market appeal currently, is talking price of approximately $13,000 per unit for limited production quantities of its new 500-hp. Model 217-6A, which will be available to manufacturers in prototype configuration next summer and should be in production a year later. The company pointed out that because of its agreements with Turbomeca, it has a line of turbines running from 350 to 1,000 hp.

Operating Time

Canadian Pratt & Whitney noted that its 500-hp. PT-6A already has some 2,000 hr. operating time and is scheduled to complete a 50 hr. test next April, with production to begin a year later. The company believes that the engine should have capability of going 1,000 hr. to overhaul within two years of FAA approval. Indications are that Canadian PWA intends to cover its turboprop bet by also having available derated versions of the PT-6A, going to 350 hp. A helicopter version of the PT-6, designated PT-6B (T-74-2) is under development for Army's light observation airplane (LOA) helicopter competition, with a sea level rating of 350 shp. on a 100-deg. day and 290 shp. rating at 6,000 ft. and 95 deg. temperature.

General Electric also expects to have its 4,000-lb.-thrust aft-span turbojet certificated in 1961 with a 600 hr. overhaul period for production models. Company notes that the CF-700 will have a fuel consumption some 15% lower than conventional jet engines of the same power and noise level will be approximately half that of a similarly rated straight turbojet. The engine system now provides guaranteed thrust reversal of 40%; with more complex design this could be bettered if desired, the company says. The manufacturer also expects to have its 2,700-lb.-thrust CJ610, civil version of the J85, certificated next year. Normal configuration would be available for 15,000-lb. gross weight or higher aircraft. A derated version can handle aircraft as small as 8,500 lb. gross weight, according to GE. Company told business pilots that the CJ610 actually is a companion powerplant to the CF-700 aft-fan, the

Cessna Plans Addition to Administration Building

New two-story office building at Cessna Aircraft Co., Wichita, Kan., is depicted in this architect's drawing. Structure (far right) connects with the west wing of Cessna's present administration building at left. Note facility for heliport.

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latter basically being a CJ-610 with the aft-fan assembly added.

Few new aircraft were unveiled at NBAA's display. Many were modifications of World War II types, such as advanced versions of the Douglas B-26. Among the noteworthy modifications of existing types were two different versions of the Beech 18 with tricycle landing gear.

Neatest of these appeared to be the Volspar version, which has been designed to handle all past, present and future models of the Model 18 up to a gross weight of 10,000 lb. for landing, and up to 10,500 lb. on takeoff. Modification was designed by engineer John Thorp, formerly of Lockheed and designer of the Sky Scooter private plane. Volspar, a contraction of the names of two Pacoima, Calif., firms (Volitan Aviation, an aircraft conversion company and Paragon Tool & Die Engineering, which specializes in turbine wheel manufacture), intends to build the kits for converting Beech 18s to tricycle configuration, but will depend upon another firm to market them. Negotiations are currently under way with several companies to handle the marketing chore.

In design of the nose gear, its loads are transmitted to the nose monocoque structure via two shear beams. The main gear, which has been moved approximately 48-in. aft, is tied to a truss bolted to the main spar, plus some additional members in the center wing to take care of added torsional loads. All three wheels use 8.50 x 10 tires. The tricycle gear retracts forward and all wheels are completely enclosed by doors.

Fuselage Enlargement

The Rausch Star version of the Twin Beech with tricycle gear also includes considerable modification to enlarge the fuselage. Rausch states that its modified Twin Beech is designed to seat up to 10, with the fuselage in the cabin area lengthened approximately 31 in. and the top of the cabin raised 11.5 in. To accommodate the new landing gear the nose has been lengthened approximately three feet. Main gear, moved rearward approximately 47 in., is tied to a new rear spar added to the wing, via two ribs extending forward. Nose gear is connected to four main fuselage beams and is full castering, but controllable 35 deg. in either direction. Price of the complete Rausch modification is given as approximately $125,000. A company representative stated that plans have been made for further development of this basic modification utilizing either the new eight-cylinder Lycoming 720 flat piston engines or Boeing 520 turboprops.

A new five-place light twin, the Saturn Meteor II, was on static display. Designed for a price of approximately $44,000 equipped, the airplane has two 180-hp. Lycoming O-360-A1A engines, a gross weight of 3,800 lb. and empty weight of 2,100 lb. At 75% power, speed is stated to be 199 mph. With total of 120 gal. fuel, including tip tanks, the Meteor II is reported to have a range of 1,100 mi. An isothalic-type reinforced plastic is used in fabricating the nose section, cabin top, vertical fin, stabilizer and elevator tips, engine cowlings, tip tanks and cabin door. Vice president and chief engineer of Saturn Aircraft Engineering, Oxnard, Calif., is C. G. Taylor.

Hiller displayed its new four-place E-4 helicopter, powered by 305-hp. Lycoming VO-540. Fitted with dual carburetion, providing 18 additional horsepower, the E-4 has a cruise speed of 90 mph., sea level range of 225 mi., maximum rate of climb of 1,340 fpm. and hover ceiling (out of ground effect) of 6,400 ft.

Sperry Phoenix Co. reported that it is setting up a nationwide distribution system for its SP-3 light autopilot system and already has reached agreement with Beech Aircraft Corp. for factory installation of the equipment and sales through the airframe manufacturer's dealer organization. Sperry is working on similar negotiations with other business plane makers. The single axis version of the autopilot, weighing 6½ lb., costs $1,818. Other axis functions can be added as desired.

FAA Installs Height-Finding Radar

Air height surveillance radar antenna, weighing almost 100 tons, is hoisted to a vertical position at National Aviation Facilities Experimental Center, Atlantic City, N. J. Developed for FAA by W. L. Maxson Corp., unit will be connected with nearby computing system to determine operating aircraft heights for traffic separation.

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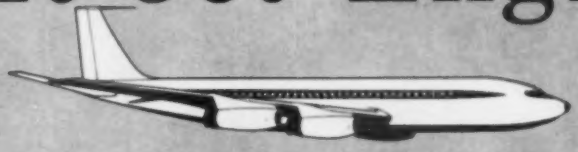

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Transistorized automatic direction finder is intended for the general aviation market.

The ADF-T-12 system, employing transistorization and printed circuits, is 70% lighter than former models. The receiver weighs 5.0 lb., indicator/amplifier 3.2 lb. and the loop antenna 1.3 lb. Frequency coverage is 190 to 1,750 kc. and ADF bearing accuracy is + or −3 deg. at levels of 100 uv/m and greater.

Motorola Aviation Electronics, Inc., Santa Monica, Calif.

Water-Methanol Filter

Full-flow filter, developed for the Rolls-Royce Dart engine water-methanol injection system, is in service on the Grumman Gulfstream.

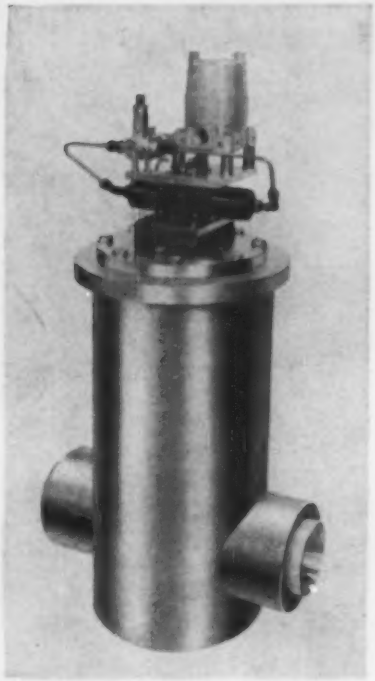
The 20-micron filter employs a stack of circular wire cloth filter elements assembled on a keyed spindle. The filter, weighing 2 lb., is fitted with a by-pass relief valve activated by a two-pound rise in pressure differential. The unit is cleaned by removing the filter stack, cleaning the individual elements and reassembling.

Screen Products, Inc., Passaic Ave., Caldwell, N. J.

Liquid Hydrogen Valves

Ball valves for liquid hydrogen handling applications are vacuum jacketed to prevent boil-off.

Available in pressure and manually operated models, the stainless steel ball



valves range in size from ¾ to 8 in. diameters. Valves are welded into the line to maintain the vacuum jacket. Top loading permits disassembly for maintenance without removing the valve from the line.

Hydromatics, Inc., 70 Okner Parkway, Livingston, N. J.

Hydraulic Servo Motor

Hydraulic motor designed to control missile tracking antennas is said to be suitable for flight control functions on missiles and space vehicles.

The CMF-02 hydraulic servo motor is less than 1 cu. in. in size and weighs 4 oz. The motor develops 0.333 hp. at 6,000 rpm; displacement is 0.02 cu. in. per revolution.

Bendix Hamilton Division, Hamilton, Ohio.

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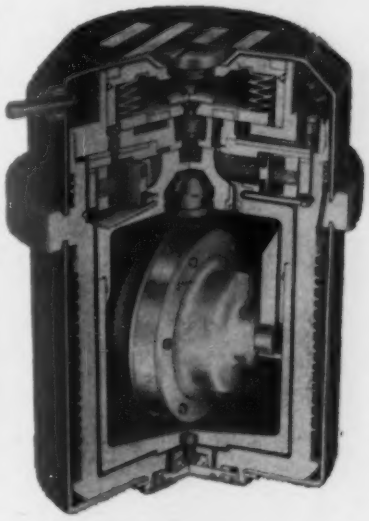
Honeywell Aero



Challenging career opportunities are offered at Honeywell in advanced projects such as continuing development of the Gas Bearing Gyro above, for inertial navigation, autopilot reference and other types of systems. Current openings:

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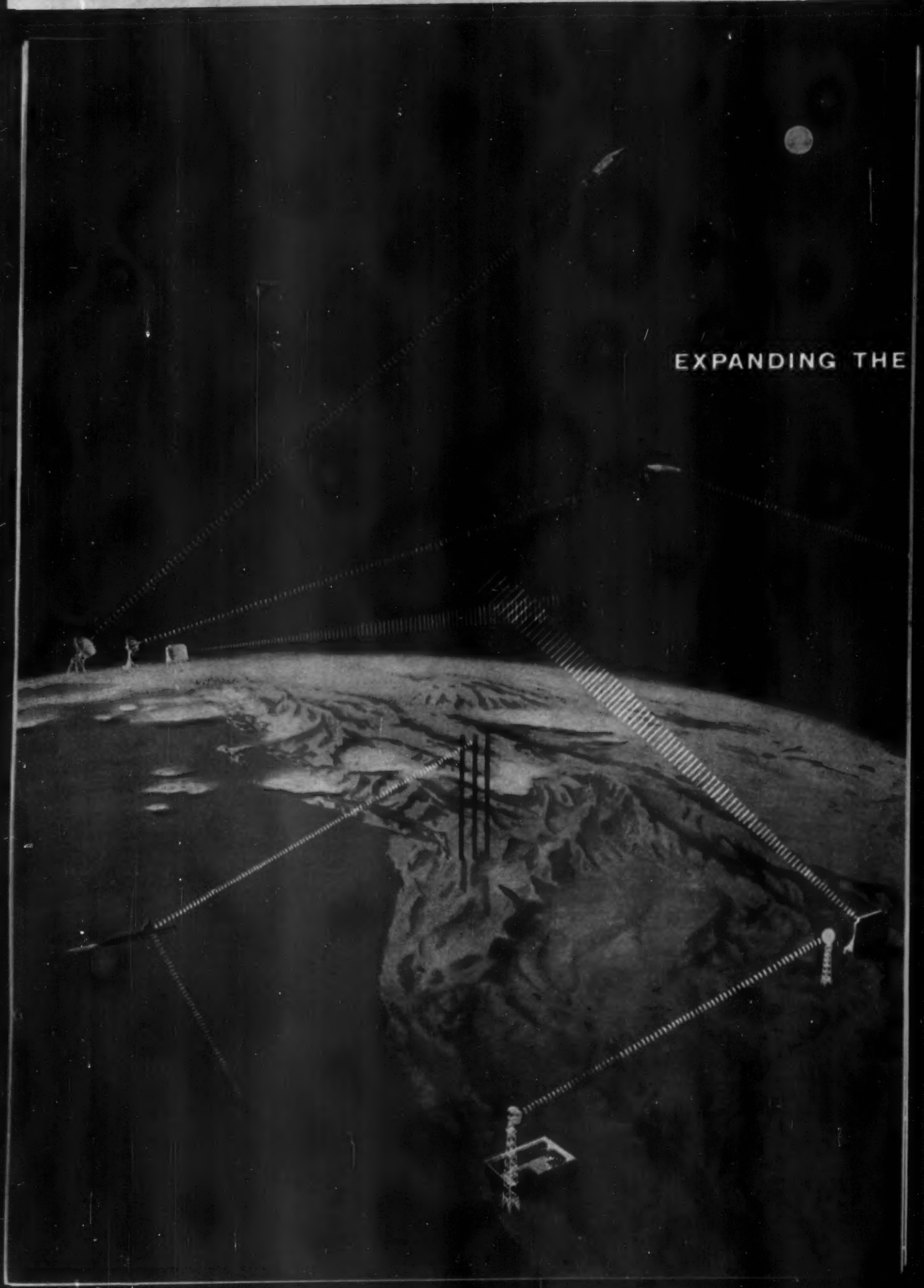
BSEE or MSEE to work on the design and development of accelerometers, gyros, and gyro-complexes. Background and experience in design and development of transistorized circuits, digital technique experience, circuit design for generating and controlling pulses and gating techniques and micro-miniaturization are most desirable.

To discuss these or other openings, write Mr. James H. Burg, Technical Director, Dept. 811, Aeronautical Division, 1433 Stinson Blvd., Minneapolis 13, Minn.

Honeywell

Military Products Group

To explore professional opportunities in other Honeywell operations coast to coast, send your application in confidence to H. K. Eckstrom, Honeywell, Minneapolis 8, Minn.


EXPANDING THE

Herodotus, the historian, records (490 B.C.) the use of burnished shields for military signaling. This was the forerunner of the heliograph, invented by Sir Henry C. Mance, which came into wide use centuries later.

FRONTIERS OF SPACE TECHNOLOGY IN

COMMUNICATIONS

Lockheed's interest in developing the science of communications extends from the depths of the oceans to deep space. Its Missiles and Space Division research programs deal with the development and application of statistical communication and decision theory in such areas as countermeasures; telemetry multiplexing and modulation; scatter communications; multiple vehicle tracking; millimeter wave generation and utilization; sonic signal detection and processing; avoidance of multipath degradation; and interference avoidance.

Associated research and development efforts are directed toward propagation studies and advanced antenna design; low noise amplifiers; vehicle borne signal transmission and reception, data storage and processing; solid state materials and devices.

The scope of such activities extends from advanced studies of naval communication problems on and under the oceans; the many applications to satellite vehicles; on to the specialized communication problems of deep space explorations. Latter needs are exemplified by high frequencies, low weight and power, high stability, low effective bandwidth, extreme reliability and basic simplicity requirements.

Engineers and Scientists: Investigating the entire spectrum of communications is typical of Lockheed Missiles and Space Division's broad diversification. The Division possesses complete capability in more than 40 areas of science and technology – from concept to operation. Its programs provide a fascinating challenge to creative engineers and scientists. They include: celestial mechanics; communications; computer research and development; electromagnetic wave propagation and radiation; electronics; the flight sciences; human engineering; magnetohydrodynamics; man in space; materials and processes; applied mathematics; oceanography; operations research and analysis; ionic, nuclear and plasma propulsion and exotic fuels; sonics; space medicine; space navigation; and space physics.

If you are experienced in work related to any of the above areas, you are invited to inquire into the interesting programs being conducted and planned at Lockheed. Write: Research and Development Staff, Dept. J-17A, 962 W. El Camino Real, Sunnyvale, Calif. U.S. citizenship or existing Dept. of Defense clearance required.

Lockheed / **MISSILES AND SPACE DIVISION**

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MIDAS and SAMOS Programs; Air Force X-7; and Army KINGFISHER

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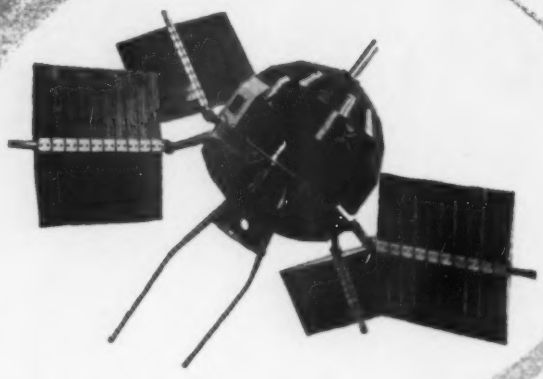
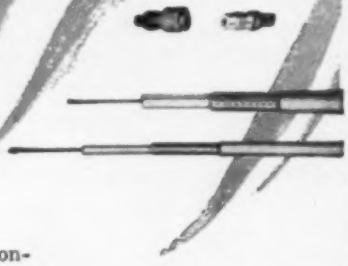


this is reliability!



Pioneer V and Explorer VI, designed and constructed by Space Technology Laboratories, are mankinds' most important satellite achievements. Pioneer V has communicated with earth across 20 million miles on its approach to the vicinity of Venus. Explorer VI has probed the Van Allen radiation belts, sending to earth the most comprehensive scientific data collected to date.

Both of these extremely successful satellites employ AMPHENOL miniature components selected for proved reliability. Potted Micro Ribbons and hex. pin and socket types, Subminax RF Connectors and Subminax Cable are used in each satellite for electrical interconnections.

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Amphenol Products in Space with Pioneer V & Explorer VI:

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Miniature Hexes
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Cable manufactured by
AMPHENOL CABLE & WIRE DIVISION
both of Chicago

AMPHENOL-BORG ELECTRONICS CORPORATION • BROADVIEW, ILLINOIS

WHO'S WHERE

(Continued from page 23)

Changes

R. M. Hatcher, manager-applied manufacturing research and process development, Convair Division of General Dynamics Corp., San Diego, Calif.

C. Edward Bold, manager-marketing operation, General Electric Co.'s Special Programs Section, Radnor, Pa.

Carey A. Evans, systems director, Precision Products Department, Nortronics Division of Northrop Corp., Norwood.

Thomas H. Mansfield, chief engineer, Servomechanisms, Inc., El Segundo, Calif.

Dr. Norman Lee Barr, head of biological sciences and systems department, General Motors Defense Systems Division, Warren, Mich.

W. E. LeVelle, manager-manufacturing, Beech Aircraft Corp.'s Boulder, Colo., Division.

Conan J. Doyle, manager of Acronca Manufacturing Corp.'s Eastern region, Defense Products Division, with offices in Washington, D. C.

Anselm Talalay, general manager, B. F. Goodrich Sponge Products, Shelton, Conn., succeeding **William R. Todd,** retiring.

P. P. Hoppe, general engineering manager, Amphenol Connector Division of Amphenol-Borg Electronics Corp., Chicago, Ill., and **C. D. Stephenson,** advanced product engineering manager.

James F. Orr, Jr., manager-product sales, Servo Corporation of America, Hicksville, N. Y.

Richard H. Horton, director of plans and marketing, National Research Associates, Inc., College Park, Md.

Perry Pollins, sales manager, Instruments Division, Laboratory for Electronics, Inc., Boston, Mass.

Ralph T. Dosher, Jr., manager, Automation Products Department, Geosciences & Instrumentation Division of Texas Instruments, Inc., Houston, Tex.

Marion E. Hines, senior scientist, Microwave Associates, Inc., Burlington, Mass.

Robert L. Jannen, head of sales and marketing, Leach Corp., Compton, Calif.

Thomas J. Horan, product manager-missile cables, Anaconda Wire & Cable Co., and manager of the company's new Anaconda Defense Electronics Services, Orange, Calif.

T. Gilbert Dunkin, assistant manager-sales engineering, Canadair, Ltd., Montreal.

Drs. Henry D. Friedman and **Robert W. Sittler** have joined the Arrow Co., Lexington, Mass.

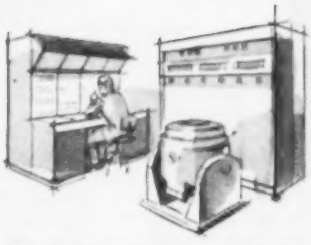
Charles E. Otterman, manager of electronic field services, National Astro Laboratories, Los Angeles, Calif., and **James R. Welker,** manager of metrology field services.

Peter Serrell has joined the Santa Monica (Calif.) engineering office of Arthur D. Little, Inc., as head of mechanical development operations.

Don Williams, manager-field engineering, On Mark Couplings, Inc., Los Angeles, Calif.

J. R. Muehlberg, manager of aviation sales, Esso Standard Division, Humble Oil and Refining Co., New York, N. Y.

New MB vibration unit extends range, accuracy and efficiency of accelerometer calibration



The C12 moving element is a solid magnesium casting. This design guarantees pure linear motion, an absolute requirement for accurate calibration. Amplifier and controls are enclosed in desk type console with ample panel space for accessories making up complete calibration system.

Now, for the first time, a single system enables you to accurately calibrate vibration transducers at any frequency from 5 to 10,000 cps with accelerations up to 100 g.

Complete and self-contained, the MB calibration system saves you space, time and money. This entirely new system incorporates all the necessary instrumentation required for fast, accurate calibration. Newly designed circuits simplify calibration procedure and eliminate special techniques.

Powered by an extremely low distortion amplifier, the MB Model C12 calibrator produces 150 pounds of high-fidelity linear force.

The new exciter-calibrator pictured above is another example of MB's continuing efforts to anticipate the needs of the environmental test engineer. It is another reason why engineers everywhere recognize that *the important advances in environmental testing come from MB.*

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BOEING SUBSIDIARY

CAB Accident Investigation Report:

C-54 Under VFR Crashes Into Mountain

On Sept. 24, 1959, at approximately 1717 A.S.T., a Douglas C-54B-DC, N 63396, operated by Reeve Aleutian Airways, Inc., as Flight 3, crashed into the northeast side of Great Sitkin Island killing all 16 persons on board.

Flight 3 was a scheduled flight between Anchorage and Shemya, with intermediate stops at Cold Bay and Adak, Alaska. A routine takeoff was made at Cold Bay, and all en route radio reporting points were made to the company within two or three minutes of their estimated times. At 1650 A.S.T., the flight reported that it was 100 mi. northeast of Adak, at 4,500 ft., on top and in the clear. Flight 3 then estimated it would be over the Adak low frequency range at 1725 A.S.T. The flight was cleared to the Adak low frequency range, to maintain VFR on top, and to call Adak approach control when 30 min. out for landing instructions. At 1715 A.S.T., the flight advised the company it was canceling its IFR flight plan and was proceeding VFR. Two minutes later Flight 3 attempted to communicate with Adak approach control. Upon hearing this message, approach control called the flight but was unsuccessful. It was later determined that the aircraft had crashed on Great Sitkin Island and that there were no survivors.

This accident occurred as a result of the pilot's failure to maintain flight in accordance with visual flight rules over hazardous terrain.

INVESTIGATION

Reeve Aleutian Airways Flight 3 of Sept. 24, 1959, was scheduled between Anchorage and Shemya, Alaska, with intermediate stops at Cold Bay and Adak. The flight was to remain overnight at Adak. The crew consisted of Capt. Eugene O. Strouse, First Officer Robert L. Pollom, Flight Engineer Brian D. Green, and Stewardesses Elizabeth A. Burke and Lorraine A. Henderson.

Prior to departing Anchorage Capt. Strouse reviewed the available en route weather data, including winds aloft and all forecasts. The forecast weather from Sequam Island to Adak for the time the flight was estimated to fly this segment was for west to northwest winds 10 to 20 kt.; scattered clouds at 1,000 ft.; ceiling 2,500 ft. broken to overcast; occasional moderate turbulence; occasional light rain or drizzle; and a freezing level between 4,500 and 5,500 ft. msl. The tops of all clouds were forecast to be 5,000 ft. A copy of this weather data was attached to the flight plan. In addition to the above weather data furnished the crew, hourly sequence reports were relayed by company radio to all its airborne aircraft. Following the review of weather conditions a flight plan was filed with, and approved by, company dispatch and ATC. This indicated a flight to Cold Bay in accordance with instrument flight rules (IFR). The aircraft was to be refueled there and an IFR flight plan filed to Adak prior to departing Cold Bay.

Flight 3 departed Anchorage at 1009[1] with 22 passengers on board. Following takeoff the aircraft was climbed to 8,000 ft., the cruising altitude, and the flight proceeded in a routine manner to Cold Bay where it landed at 1330. Eleven passengers were deplaned.

The aircraft was refueled during the short stay at Cold Bay and Capt. Strouse, according to plan, refiled an IFR plan to Adak. This flight plan specified a cruising altitude of 1,000 ft. on top direct to Akutan intersection, thence direct to Adak. The estimated elapsed time was three hours plus 10 minutes with eight hours and 40 minutes of fuel on board; alternates were Umnak and Shemya. Prior to takeoff the aircraft was cleared by approach control as follows: "Cleared out of Cold Bay control area 50 mi. southwest via Mordvinof intersection, maintain VFR conditions on top."

Flight 3 departed Cold Bay at 1419 and reported over the Cold Bay low frequency range one minute later. At this time the flight reported the tops of clouds to be 1,200 ft., occasionally 1,600 ft., and advised that it would climb to and maintain 4,500 ft.; it also estimated the Mordvinof intersection at 1445. The flight was then cleared by approach control to make all further radio contacts with company radio. The flight reported it was at Mordvinof intersection at 1445, 4,500 on top, and estimating Akutan intersection at 1458. Arrival time over Akutan was reported as 1458, estimating Easy I at 1524. The flight reported reaching this checkpoint at 1527 and estimated arrival at Easy II[2] at 1555. At 1552 arrival over Easy II was reported and the next checkpoint, 100 mi. northeast of Adak, was estimated as 1652. This checkpoint was reported at 1650, at which time the flight advised it was 4,500 on top and estimated the Adak low frequency range at 1725. At this time the company advised the flight that ATC had cleared it to the low frequency range, to maintain VFR on top, and to call Adak approach control on 126.18 megacycles when 30 mi. out for landing instructions. The altimeter setting was then given as 29.95.

Twenty-five minutes later, at 1715, Flight 3 advised the company it was canceling its IFR flight plan and proceeding VFR. Just two minutes after this message was received, Adak approach control heard the following radio transmission from the flight: "Adak approach control from Flight 3, 126.18." Approach control answered the flight within a few seconds but neither this nor any subsequent attempt to reach the flight was successful. The voice of the person making this last call was judged by the Adak controller to be normal.

When the flight was 23 min. overdue, Search and Rescue was notified and a concerted effort was begun to locate the missing aircraft. At 1850 a Navy aircraft reported seeing an orange-colored fire at approximately the 2,000-ft. level on the northeast side of Great Sitkin Island. This was later confirmed to be the burning wreckage of the missing aircraft.

Civil Aeronautics Board investigators arrived at Adak the following morning at 0600. Conferences were immediately initiated with officials of Reeve Aleutian Airways, the United States Navy, and the Federal Aviation Agency. The trip from Adak to Great Sitkin Island was made early the morning of Sept. 26. Because of sea conditions and the rugged coastline of the island, this trip necessitated the use of a U. S. Navy tugboat, the USCG Clover, a small motor launch, and finally, rubber rafts for beaching. After landing, a detachment of Marines guided the party to the accident scene.

Great Sitkin Island is composed of volcanic rock which rises from the ocean to a height of 5,740 ft. The island is approximately 14 mi. wide in any direction. The wreckage was located on the northeast side of the island at an elevation of 2,100 ft. on a 30-deg. slope. It was determined that at impact the aircraft was making a right climbing turn and that it struck the mountain when heading 285 deg. magnetic. Initial contact with the sloping ground was made by the left outer wing panel followed in sequence by the left horizontal stabilizer, the Nos. 1 and 2 powerplants, the fuselage, and the Nos. 3 and 4 powerplants. The empennage separated from the aircraft and remained in the initial impact area; all four propellers were found in this area. Wreckage was distributed over a distance of 411 ft. Engines Nos. 2 and 3 were found in a ravine 400 ft. below and to the right of the main wreckage.

The forward section of the fuselage, including the cockpit and nose section, and the right wing were destroyed by impact forces and the fire which followed. Fire seriously damaged the left wing, left landing gear and housing, and the No. 1 engine. All landing gears were retracted when the accident occurred.

An examination of the propeller domes of Nos. 1 and 2 propellers showed that the blades of these propellers were positioned 18 and 23 deg., respectively, from their low-pitch stops. These readings indicated that the engines were developing power at impact. Dome readings of the other two propellers could not be obtained.

Readings of all instruments recovered were determined to be unreliable. No evidence was found which indicated that a

[1] All times herein are Alaska Standard based on the 24-hr. clock.

[2] Easy I and II are navigational fixes along the route determined by cross bearings with radio beacons.

malfunction of the aircraft or its components had occurred or that fire had occurred prior to impact. Examination of the company's maintenance records showed the aircraft to be in an airworthy condition for this flight.

It was further determined that the pilot, copilot, and flight engineer were in their respective seats with their safety belts buckled and that all passengers were seated with their seat belts fastened at impact. No additional information of value was obtained at the accident site.

On Sept. 24, 1959, at the time of the accident, the weather was as follows: Great Sitkin Island was located in a cool area with high pressure cells to the north and south and low pressure areas to the east and west. One low pressure area was centered south of Anchorage, the other just east of the Kamchatka Peninsula. There were no fronts or squall lines affecting the route of the flight.

Each day at 0800 the U. S. Weather Bureau station at the Anchorage Airport issues for Reeve Aleutian Airways a 12-hr. route forecast covering the Aleutian chain as far west as Shemya. On the day of the accident this forecast drew attention to the low pressure areas previously mentioned and described their anticipated movement. It was further indicated that west of Dutch Harbor along the chain there would be scattered to overcast clouds based at 1,000 ft.; a broken to overcast cloud deck above 2,500 ft., tops 5,000 to 10,000 ft.; with brief periods of light rain. The freezing level was forecast to be approximately 5,000 ft., with light icing occurring between this level and 10,000 ft. Occasional moderate turbulence could be expected between King Salmon and Adak. Between Dutch Harbor and Adak winds aloft at the 8,000-ft. level were forecast to be 360 deg. at 25 kt. Winds aloft at lower levels were not contained in this forecast.

The Adak terminal forecast, prepared by the Weather Bureau at Anchorage for the period 1300 of the 24th to 0100 of the 25th, called for a broken ceiling at 2,000 ft. with north-northwest winds at 15 kt. and occasional light rain.

Surface weather observations recorded at Adak at 1645 indicated broken clouds (8/10 coverage) based at 1,500 ft., with a broken deck above (1/10 observed) based at 7,000 ft.; visibility 7 mi.; wind west 11 kt.; temperature 52; dewpoint 48; altimeter setting 29.95.

Prior to the accident a Navy pilot arriving at Adak 1635 reported a solid overcast at 7,000 ft. and CAVU (ceiling and visibility unlimited) above from 100 mi. northeast of Adak. He did not observe Great Sitkin Island.

Between 1900 and 2030 another Navy pilot flying low near the crash site described the cloud coverage as broken, ceiling 2,000 ft.

The company dispatcher on duty at Anchorage the day of the flight said that he personally checked the weather information in the Weather Bureau office prior to reporting for duty at 0600. He said also that he briefed Capt. Strouse at 0900 and after this the first officer prepared the flight plan; the flight was then cleared to Cold Bay. He said all dispatching of the flight both at Anchorage and en route was accomplished in a routine manner.

Capt. Strouse was first employed by the company in 1950 as a copilot. He was upgraded to captain on DC-3 equipment early in 1951 and served in this capacity until September, 1955. From this date until March, 1957, he was employed elsewhere. He returned to the company in March, 1957, as a captain on DC-4 equipment, became senior check pilot in June, 1957, and chief pilot in February, 1958. He had a total of 12,853 flying hours, of which 1,278 were as captain on DC-4 aircraft.

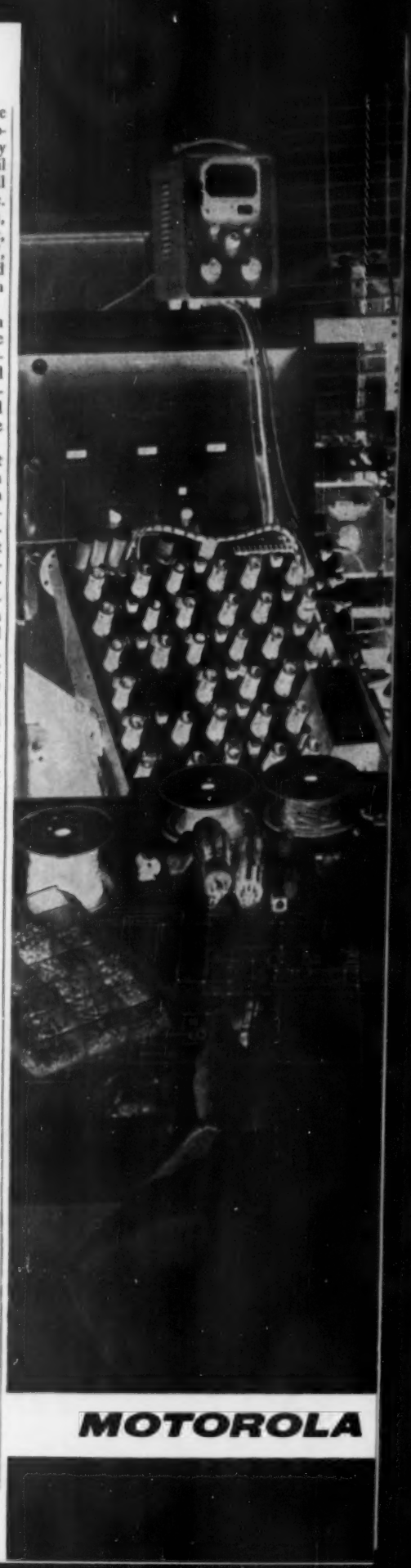
As chief pilot, Capt. Strouse had certain company responsibilities. Among these were: pilot training, including proper accomplishment of all pilot en route and proficiency checks when due; the maintaining of all records pertaining to flight; and the maintaining of records pertaining to the currency of pilots' medical certificates.

An examination of the captain's pertinent flight records indicated that he had taken the prescribed medical examination when due. These dates were noted on a company record entitled "Pilot Five Year Record." However, these records conflict with the records of the local Federal Aviation Agency medical examiner and the Airmen Records Branch of the Federal Aviation Agency in Washington, D. C., which indicate that his last first-class medical examination was taken Mar. 26, 1956. Company flight records also indicated that Capt. Strouse and two other captains were overdue for their proficiency checks. Both of these deficiencies are contrary to Civil Air Regulations. In the former instance it is obligatory for the pilot to take a prescribed physical examination each six months in order to validate his airline transport pilot certificate, which is required of a captain. In the latter, an airline pilot cannot legally serve as a captain unless these prescribed checks are taken and passed.

Separate and distinct from the responsibilities of Capt. Strouse are those of the company as prescribed in Civil Air Regulations. These, in part, require that adequate flight records be maintained at all times to be certain of compliance with existing regulations. In this case there were records in the company files indicating that Capt. Strouse had taken each succeeding physical examination required after Mar. 26, 1956. However, there were no Federal Aviation Agency or designated medical examiners' records found to substantiate these.

A Federal Aviation Agency representative testified that they had made periodic spot checks of the company's records and had found nothing to indicate that they were not in order. He further testified that if a pilot was asked if he had a valid medical certificate and he replied "yes," the Federal Aviation Agency inspector was not required to actually inspect the certificate for validity.

When it was learned that Capt. Strouse apparently had not had a valid medical certificate for a period of approximately three years, inquiries were made of other local medical examiners by the Board investigators to ascertain if, in fact, an examination had been taken and not recorded; none such was found. These inquiries disclosed that Capt. Strouse had consulted with an ophthalmologist in Anchorage on Aug. 14, 1958. The records of this examination indicate that his visual acuity was 20/40 either eye with correction, and intraocular



EVOLUTION & REVOLUTION

REVOLUTION in electronics may have its genesis in the *evolution* and synthesis of four prime areas: the rapidly maturing technologies of semiconductor development and production, surface passivation and stabilization research, electronic ceramic engineering and controlled thin film deposition. Synthesis of effort in many scientific and engineering disciplines is required to achieve breakthroughs in these areas and accelerate the evolution from conventional to microelectronic circuitry. The Solid State Electronics Department of Motorola's Military Electronics Division is exploiting this approach as the key to long life and reliable performance of electronic equipment by eliminating excessive complexity in component interconnection.

RELIABILITY improvement demands a reduction in the number of point-to-point connections used in equipment design. Highly specialized engineers, physicists and chemists, at Motorola, are making significant contributions to the new art of non-topological integrated circuitry. All well-qualified scientists and technicians seeking professional growth will find stimulation and challenge in the Motorola Solid State Laboratories.

RECOGNITION and reward will be won by those who, by disciplined research in integrated circuits, help secure unconditional reliability. Write to the office in the area of your choice.

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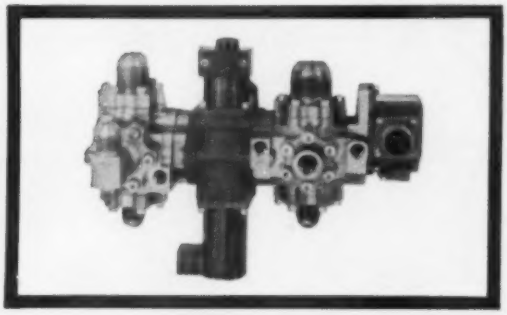
The ability of KEL-F Plastic to perform efficiently in "impossible" environmental conditions is the reason Fluorulon Laboratories, maker of the seals, recommend them for such rugged applications. KEL-F Plastic is ideally suited for many uses in the field of rockets, missiles and aircraft. It exhibits zero moisture absorption, high dimensional stability, excellent moldability, electrical and mechanical properties. Inquire about the complete family of 3M Chemicals—Molding Powders, Dispersions, Elastomers and Fluids, Fluorochemical Inert Liquids, and specialty chemicals—for these fields. Write on your company letterhead, specifying area of interest, to 3M Chemical Division, Dept. KAW-100, St. Paul 6, Minnesota.

"KEL-F" is a Reg. T.M. of 3M Co.



CHEMICAL DIVISION

MINNESOTA MINING AND MANUFACTURING COMPANY

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pressures 27-28-30 were found in each eye. These records were carefully studied by the Eye Research Foundation of Bethesda, Md., recognized experts in this field. This organization determined that glaucoma was present as well as cerebrovascular disease. The extent to which the patient was affected by these conditions could not be determined without an autopsy being performed and it was impossible to perform an autopsy. Among the clinical states which are considered likely to occur in varying degrees as a result of this type of cerebrovascular disease are: total immobilization, partial immobilization, and disturbance of memory, judgment, and reasoning.

Part 29.2 of the Civil Air Regulations clearly states what is required of an applicant to obtain a first-class medical certificate[3].

ANALYSIS

The Board recognizes the fact that Capt. Strouse was held in high esteem by his company and was in a position of trust; also, that the keeping of all flight records was left entirely up to him. The Board also recognizes the company's responsibility to maintain adequate records to assure compliance with 41.53(i)[4] of the Civil Air Regulations. In this instance, a review of the record of Capt. Strouse would have indicated that his medical examination had been taken as prescribed. However, overdue proficiency checks should have been found.

As previously indicated, Capt. Strouse's medical certificate was not current; his last medical examination, required each six months, had been taken some three years previously. As chief pilot of the company, as well as being a company agent responsible for the maintenance of pilot records, Capt. Strouse was in a position where he readily could have falsified his own records. The Board believes that if an FAA inspector had asked for Capt. Strouse's medical certificate to examine it, during the three years it was not current, the lack of its validity would have been discovered.

Great Sitkin Island was completely obscured by clouds of an orographic formation above the 1,500-ft. level. Clouds surrounding the island were in two layers. The upper layer was thin with its top at 7,000 ft. and its base somewhat below this level. The lower layer had its top at 4,000 ft. and a base at 1,500 ft. Each layer virtually created an overcast condition with very small breaks, if any, in the lower deck. Both layers converged over Great Sitkin Island resulting in a solid cloud condition. There was no fog, precipitation, or turbulence of

[3] "29.2 First Class (a) Eye. Applicant shall have: (1) A visual acuity of at least 20/20 in each eye separately without correction: Provided, that if the vision in either or both eyes is not poorer than 20/50 and is brought up to 20/20 or better in each such eye by glasses, the applicant may be qualified upon condition that correcting glasses be worn while exercising the privileges of his airman certificate."

[4] 41.53(i) QUALIFICATION REQUIREMENTS: (a) No air carrier shall utilize any flight crew member or dispatcher, nor shall any such airman perform the duties authorized by his airman certificate, unless he satisfactorily meets the appropriate requirements of 41.48 etc.

41.48 Certificate. (a) Any pilot serving as pilot in command shall hold a *valid* airline transport pilot certificate and a rating for the aircraft in which he is to serve.

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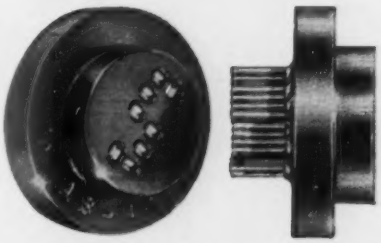

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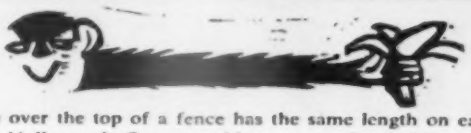
PROBLEMATICAL RECREATIONS 34



A rope over the top of a fence has the same length on each side. Weighs ⅓ lb. per ft. On one end hangs a monkey holding a banana, and on the other end a wt. equal to the wt. of the monkey. The banana weighs 2 oz. per inch. The rope is as long as the age of the monkey, and the wt. of the monkey (in ounces) is as much as the age of the monkey's mother. The combined ages of monkey and mother are 30 years. ½ the wt. of the monkey, plus the wt. of the banana, is ¼ as much as the wt. of the wt. and the wt. of the rope. The monkey's mother is ½ as old as the monkey will be when it is 3 times as old as its mother was when she was ½ as old as the monkey will be when it is as old as its mother will be when she is 4 times as old as the monkey was when it was twice as old as its mother was when she was ⅓ as old as the monkey was when it was as old as its mother was when she was 3 times as old as the monkey was when it was ¼ as old as it is now. How long is the banana?

—*UCLA Engineering Student Newsletter*

Our Airtron Division announces a dummy load which, without liquid cooling, dissipates 8 Kw of average power and 2200 Kw of peak power. A liquid-cooled version handles considerably higher powers.

ANSWER TO LAST WEEK'S PROBLEM: This problem involves a factorable second degree polynomial, namely: $N^2 - 1 = P = aaabbbccc = (10^6 a = 10^3 b + c)\ 111 = (N + 1)(N - 1)$, one is led to possible ranges of N, viz., 21083, 18251, 18249, 14917, and 10583. Dividing the factors of the polynomial by the divisor 3 or 37, gives the unique solution: $111999888 = (10583)^2 - 1$.

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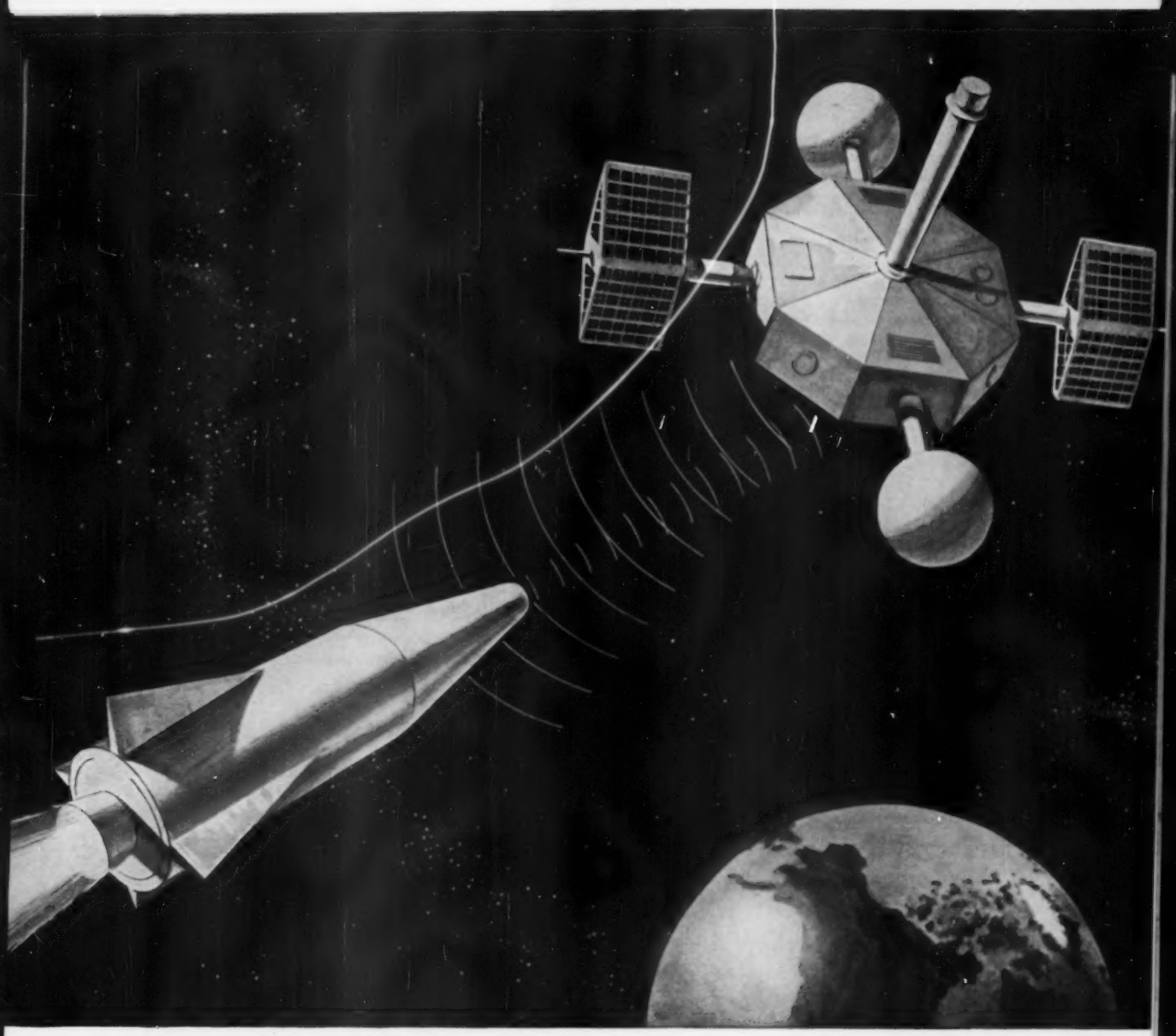

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any consequence immediately adjacent to the route involved.

Capt. Strouse was an experienced DC-4 pilot and had acquired several years of experience flying this route while employed by Reeve Aleutian Airways.

Throughout the flight from Cold Bay to the last reporting point all reporting points were reached approximately when estimated. From this fact it must be concluded that Capt. Strouse could have easily computed his position at the time he canceled the flight plan and should have known approximately how far he was from the only obstacle of any proportion along the course. Since Great Sitkin Island is 5,740 ft. in height, and at the time was obscured from the pilot's view by converging cloud layers as well as the orographic formation surrounding the mountain, and since the flight was cruising IFR on top at 4,500 ft., it is obvious that a change of course or altitude had to be made to avoid it. If the captain had elected to continue IFR, under the existing weather conditions, he would have had to change course, climb and maintain VFR on top, or request an amended clearance for an altitude assignment of at least 8,000 ft. (the minimum en route altitude). To do this would have taken very little extra time and this should not have been a deciding factor because the airplane was to remain overnight in Adak and no other uses were scheduled for it. Capt. Strouse did not elect to take any of the above courses of action, but instead decided to cancel IFR and proceed VFR.

At the time this decision was made, the aircraft was computed to be approximately 35 naut. mi. from its destination and about 9 naut. mi. from Great Sitkin Island. Due to the lack of precise information, it is not definitely known what the cloud coverage was where the descent was begun; however, it is believed that it was slightly better than that in close proximity to Great Sitkin Island. It is logical to assume that a pilot with this captain's experience and background would not deliberately descend into a solid cloud condition after stating that he was going to proceed VFR. He must have thought he could descend to a safe altitude below the clouds in accordance with visual flight rules and proceed in this manner to his destination.

Since the aircraft was apparently in the clouds just prior to impact, the Board concludes that the pilot, for reasons unknown, did not continue to maintain visual reference to the extent necessary to navigate successfully through hazardous terrain.

The Board further concludes that the pilot did not know his exact position when he began the descent and thought he was either to the right or left of course or beyond the mountain.

It cannot definitely be determined to what degree, if any, the cerebrovascular disease from which the captain suffered contributed to this accident. However, the fact that poor judgment is one of the results of this disease, it is possible that this may have caused him to attempt to proceed visually under conditions in which better judgment would have caused him to be more cautious.

In any event the Board must conclude that the failure to maintain flight over hazardous terrain, in accordance with visual flight rules, was not compatible with the degree of judgment expected of an airline pilot.

The company has taken the following corrective action: All approaches into Adak are to be made in accordance with instrument flight rules. Photographic copies of each pilot's medical certificates are to be made upon the pilot's receipt of the certificate and placed in the file.

The Board determines that the probable cause of this accident was the captain's failure to maintain flight in accordance with visual flight rules during a descent over hazardous terrain.

By the Civil Aeronautics Board:

Whitney Gillilland, Chairman
Chan Gurney, Vice Chairman
G. Joseph Minetti, Member
Alan S. Boyd, Member
J. S. Bragdon, Member

SUPPLEMENTAL DATA

The Civil Aeronautics Board was notified of the accident at 2332, Sept. 24, 1959. An investigation was immediately initiated in accordance with Section 701(a)(2) of the Federal Aviation Act of 1958. A public hearing was ordered by the Board and was held in Anchorage, Alaska, Oct. 13, 1959.

Reeve Aleutian Airways, Inc., is an Alaskan corporation with its principal office in Anchorage, Alaska. The corporation operates as an air carrier under a certificate of public convenience and necessity issued by the Civil Aeronautics Board and an operating certificate issued by the Federal Aviation Agency. These certificates authorize the carrier to engage in air transportation of persons, cargo, and mail within the United States.

Capt. Eugene O. Strouse, age 49, was employed by Reeve Aleutian Airways as a copilot May 27, 1950. He held an airline transport pilot certificate with DC-3, DC-4, Sikorsky S43, and Curtis C-46 type ratings. His last proficiency check was taken Sept. 14, 1958. His last FAA first-class medical examination was taken Mar. 26, 1956. He had a total of 12,853 flying hours, of which 1,278 were in DC-4 equipment.

First Officer Robert L. Pollom, age 38, was employed by the company July 7, 1958. He held a valid commercial pilot certificate with an instrument rating. His last FAA second-class medical examination was taken June 15, 1959. He had a total of 3,949 flying hours, of which 883 were in DC-4 aircraft.

Flight Engineer Brian D. Green, age 30, was employed by the company June 26, 1958. He held a valid flight engineer certificate and a mechanic certificate with an airframe and powerplant rating. He had accumulated approximately 312 hr. as a flight engineer.

Stewardess Elizabeth Ann Burke, age 24, was employed by the company Sept. 19, 1958.

Stewardess Lorraine Ann Henderson, age 26, was employed by the company Nov. 11, 1958.

N 63396, a Douglas C-54B-DC, was manufactured Dec. 10, 1944, and was purchased by Reeve Aleutian Airways, Inc., Mar. 7, 1957. The aircraft had accumulated a total of 38,390:46 hr. since new and 4,151:52 hr. since overhaul. The aircraft was equipped with four Pratt & Whitney R-2000-7M2 engines and Hamilton Standard propellers, Model 23E50-505.

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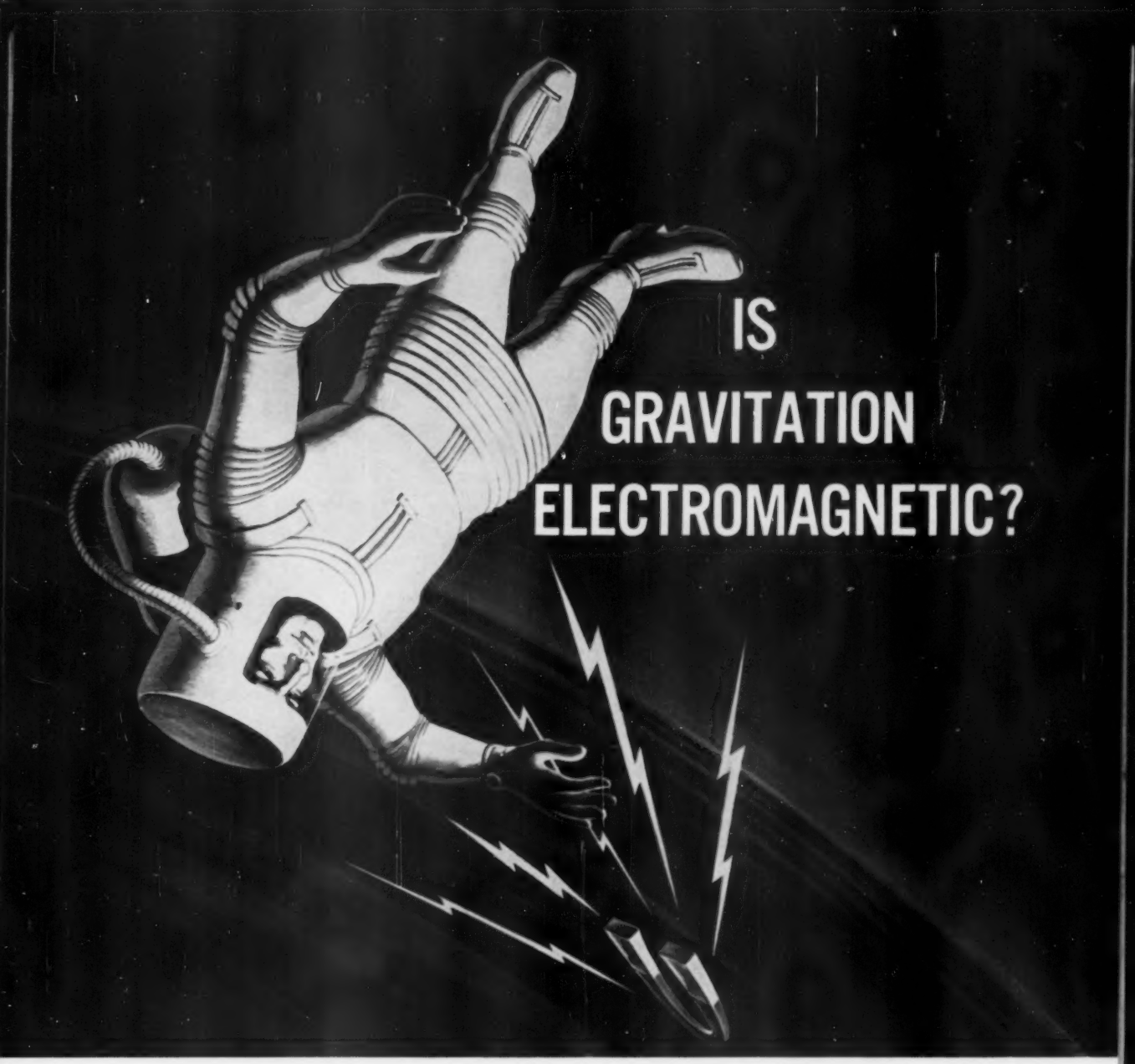

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ALPA Urges Upgrading Of Airport Safety Aids

Chicago—Reduction of airline accidents through nationwide improvement of airport safety aids is called for by the Air Line Pilots Assn., which disclosed the partial results of an extensive survey of airport equipment at the recent ALPA Safety Forum here.

In an initial report covering 30% of the airports to be surveyed, Carl F. Eck, representing the union's safety and engineering department, said that while ALPA anticipated the results obtained so far, the degree of deficiencies discovered was very significant.

Major points, brought out in an analysis of 170 survey forms tabulated as of this month, were:

- **More runway lighting** and marking is needed at 62%.
- **Rescue and fire-fighting** services are below standard at 92%.
- **Runway visual range** equipment is not available at 96%.
- **Marginal snow removal** equipment and procedures exist at 50%.
- **ILS approach facilities** are lacking at 67%.
- **Airport surveillance radar** is not installed at 86%.
- **Tower facilities** are not available at 58%.
- **Insufficient obstruction** lighting and marking exists at 76%.
- **Taxiways are in need** of repair and extension at 47%.
- **Ramp and parking** facilities need improvement at 36%.
- **Inadequate runway clear zones** and overrun areas exist at 60%.
- **Additional approach lighting** and runway end identification lights are needed at 70%.
- **Additional taxiway lighting** and marking is required at 51%.

Among pilot comments in the survey were several complaints that dirt piles, construction materials and generally poor runway conditions at La Guardia Airport amounted to "booby traps." Referring to the recent American Airlines Electra accident at La Guardia (AW Sept. 19, p. 38), one ALPA spokesman noted that "just as sure as we're sitting here that thing was predicted."

The problem of skid resistance on airport runways was discussed. Pilots went on record as favoring more research, development and operational testing of abrasive additions to concrete and asphalt runway surfaces.

FAA representatives replied that the agency has been studying the problem and is considering a full scale project to solve it, after the completion of some basic research now being completed by NASA.

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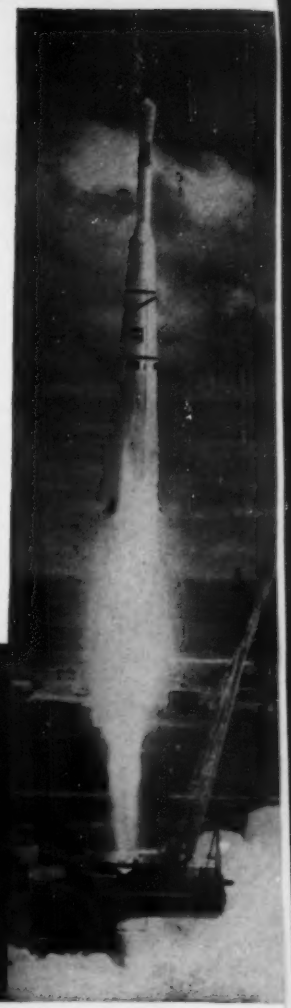

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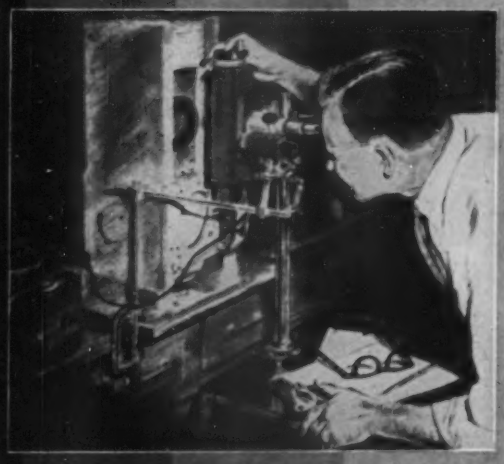

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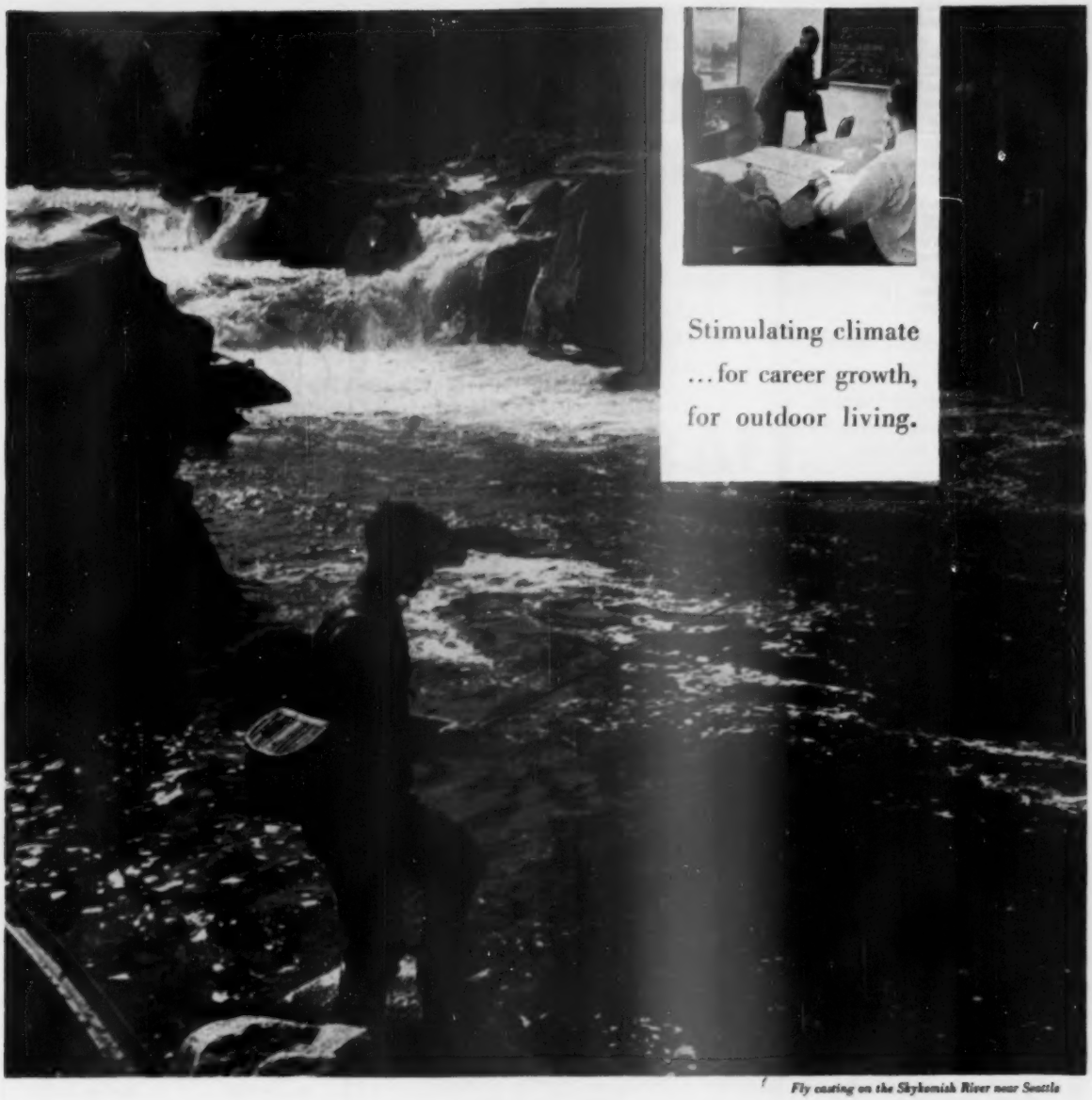

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LETTERS

True Cooperation

We much appreciated at SFERMA (Societe Francaise d'Entretien et de Reparation de Materiel Aeronautique) the extensive coverage given in your Sept. 5 issue (p. 112) about our "Turbo Travel Air" project.

A very accurate report has been given from a technical point of view.

The commercial point of view speaks for itself, but I wish to emphasize the short field capabilities of this aircraft which put it in a class apart from other high performance executive aircraft.

All these things could not have been done without the total assistance given us by Beech Aircraft Corp., which leased us a brand new airframe and gave us much technical advice; Turbomeca Co., which leased the engines; and the Ratier-Figeac Co., which did the same for the propellers. This is a true common venture project, and I think the first to associate an American company, prominent in its field, and three specialized French companies without a single cent of government money being spent, but in a wonderful spirit of cooperation.

PAUL BADRE
President, SFERMA
Paris, France

U-2 Pilot Award

I think it is time for someone to step out and say what many Americans are thinking yet few take the trouble to set forth in concrete terms.

First, however, allow me to clear the air. I am not now, nor have I ever been, employed by the aircraft industry. I have never been attached to any of the flying services during my military service. I do admit to being interested in aviation and very thankful to be an American.

I believe it is time for the American people to take a little democratic action and show Mr. Khrushchev and the world what Americans really think of men like Francis G. Powers.

Because of diplomacy, world politics and other devices of tact, our government has not been able to take a truly strong stand for Francis Powers during his trial. That does not mean that our people cannot show their gratitude for the men flying the dangerous but necessary reconnaissance missions in this age of survival.

With this idea in mind I suggest that a Francis G. Powers Award be given each year to an individual, flight group, research group or aircraft company that made a significant contribution in the field of aerial reconnaissance. A perpetual trophy and suitable plaques would be adequate.

Reasons for the institution of such an award are manifold. First and foremost, in my mind at least, is let us not forget that Francis Powers is imprisoned in Soviet Russia and will be for a long, long time.

Secondly, let the Russians and the world know there are Americans who believe in standing firm for the rights and privileges of free men. Let it also be known that we are willing to take the chances and shoulder the responsibility for action necessary to preserve this freedom. When we, as free individuals, begin to show our indignation and begin taking strong individual and group stands in matters of international affairs, you may rest assured that the Kremlin will re-evaluate our national psychology. Their attitude will change from one of "let's keep pushing" to one of "do we dare push further?"

The Francis G. Powers Award made on an annual basis and publicized through our news media will show that we Americans do respect individual efforts, that we do stand behind the dangerous but necessary action required to preserve ourselves and the world from catastrophic surprise attack and that we shall not forget Francis Powers.

I have merely presented an idea. Perhaps some of the readers of AVIATION WEEK who are in a position to organize and act will pick up the ball and carry the idea to fruition.

Some cynics will say that Francis Powers and other U-2 pilots were paid extremely well, and that in itself is sufficient reward. To them I say this: Gentlemen, if you were paid twice the salary would you fly over Russia?

I owe a great deal to men like Francis Powers and his fellow pilots in RB-47Es, RB-57Ds and U-2 aircraft. All of us do. I humbly thank them.

JOHN ZAWISKI
Aeronautical Illustration Historian
Elgin, Ill.

Aviation Week welcomes the opinions of its readers on the issues raised in the magazine's editorial columns. Address letters to the Editor, Aviation Week, 330 W. 42nd St., New York 36, N. Y. Try to keep letters under 500 words and give a genuine identification. We will not print anonymous letters, but names of writers will be withheld on request.

Swing Tail Amphib

While we appreciate the interest that a small item in the Industry Observer column (AW July 18, p. 23) has stirred up concerning our four turbofan engine swing tail amphibian, we think it is presumptuous of Cmdr. T. E. Maurer, USN Ret. (AW Aug. 29, p. 110) to write off the feasibility of our confidential proposal to the Army on the basis of this meager information.

We are fully cognizant of all the problems of transferring cargo at sea, and the limitations that confront this or any military operation because of bad weather or other adverse conditions. Constructive criticism could help on some of these problems, but we at Air Craft Marine Engineering do not succumb to Cmdr. Maurer's pitfalls and doubts, we aim to solve them. The first two points he raises result from weather which no one is yet able to control. The last three we encompass with our advanced design.

We believed the Army's greatest need is true air mobility that can best be served by a high performance, STOL, turbofan-powered, small transport with amphibious versatility. The operation the commander is worried about is only one of many of our amphibian's capabilities. The delivery of four tons of personnel and cargo to an inaccessible clearing 3,000 mi. away in less than 7 hr. is its primary mission.

Maybe the commander thinks dumping men and materiel over the side into landing craft or amphibious vehicles which proceed to shore at 5 kt. through hazardous surf and possible enemy action is a neat operation. And how many days will it then take to get the battle group inland where it is needed?

Our amphibian can operate from carriers, any small body of water or rough, unprepared fields and provide the Army the high speed, low cost, practical mobility that is so lacking now. By refueling from sub, ship or land base the ACME A-2 can deliver its load any place in the world and faster than any projected military transport.

Incidentally, we will let the commander know we don't have any wheel wells, and we do have a very capable structural design group who relish advanced concepts. Maybe it's a good thing the commander is retired because we are sure negative philosophy will never help reverse the tide of Red aggression.

ROBERT M. BERNS
President
Air Craft Marine Engineering Co.
Van Nuys, Calif.

Back to Seattle

Sixty five hundred Boeing employes who work at the company's developmental center cannot be convinced, even by your fine magazine, they are at Cape Canaveral, Fla. Your caption for the photograph appearing in the lower left corner of p. 57, AVIATION WEEK, Sept. 5, indicates they and the entire Seattle test program for the Minuteman weapon system have been moved from Seattle, Wash., to the Atlantic Missile Range.

Also, Maj. Gen. O. J. Ritland, lower right corner, same page, believes he was looking at the command and control console for a flight of Minuteman missiles. The console was located in the full mockup of an operational underground launch control center.

We would appreciate it very much if you would return our people and correct the impression of the console being designed for test firings at the Cape.

TOM RIEDINGER
Boeing Airplane Co.
Seattle, Wash.

(AVIATION WEEK's caption should have made clear that the Cape Canaveral layout diagram has been superimposed on a photograph of Boeing's Seattle plant. The picture layout included both the Minuteman complex at the Cape and hardware shown at the Ballistic Missile Division inspection at Seattle.—Ed.)

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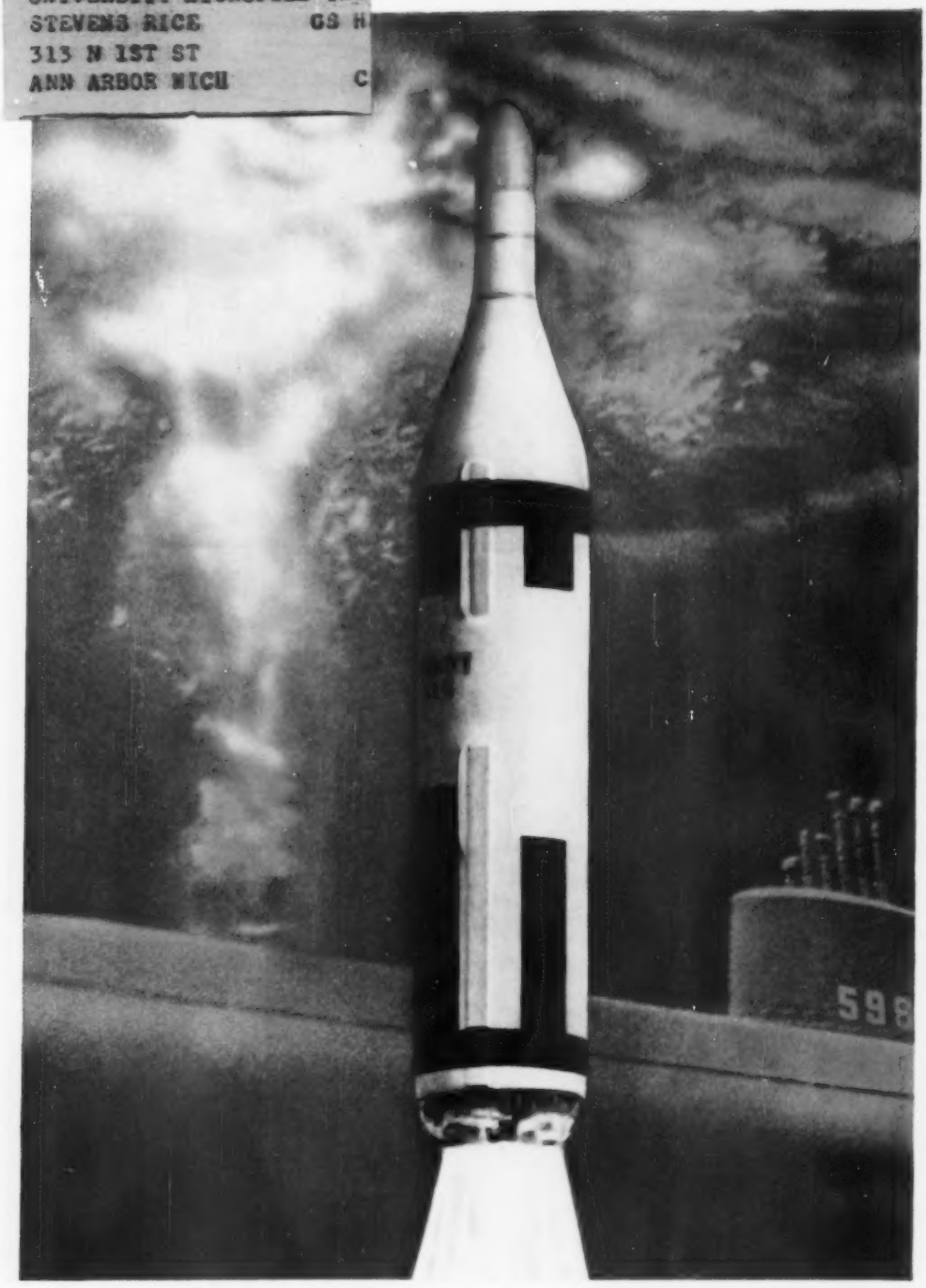

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